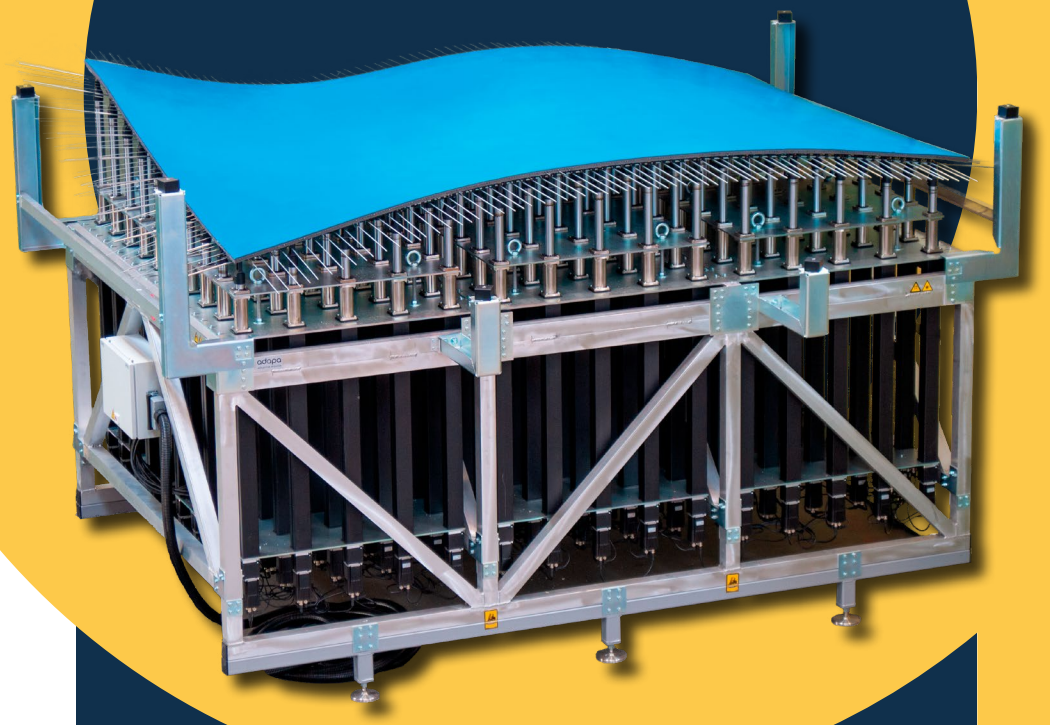
adapa

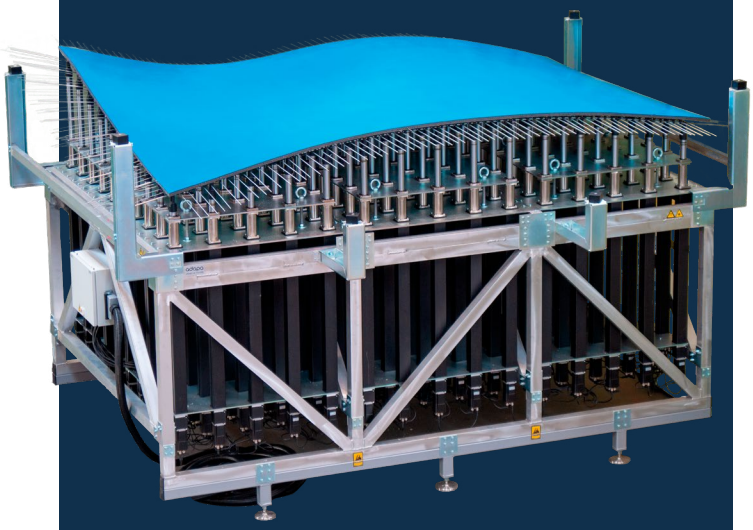
adaptive moulds

The worlds leading supplier of intelligent reconfigurable moulds for curved surfaces

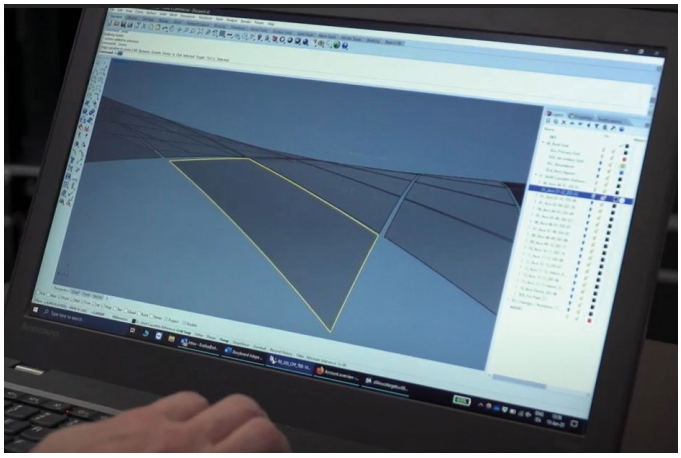


Our adaptive moulds enable manufacturing companies to produce low-repetition curved designs faster, affordably, and more sustainable than alternative technologies

Project 3D file is used for panelization and defining laser guidance markings, and transferred to the control unit



Even “last-minute” changes can be fabricated as “just-in-time” for delivery and assembly on-site



The adaptive mould automatically take the shape in 5 minutes and forming or casting process starts

Last minute changes to 3D file are easy to do 5 minutes from 3D file to mould surface
No physical mould storage – just a memory stick

OUR ADAPTIVE MOULD TECHNOLOGY SHAPE EXPERIENCE OF THE FUTURE

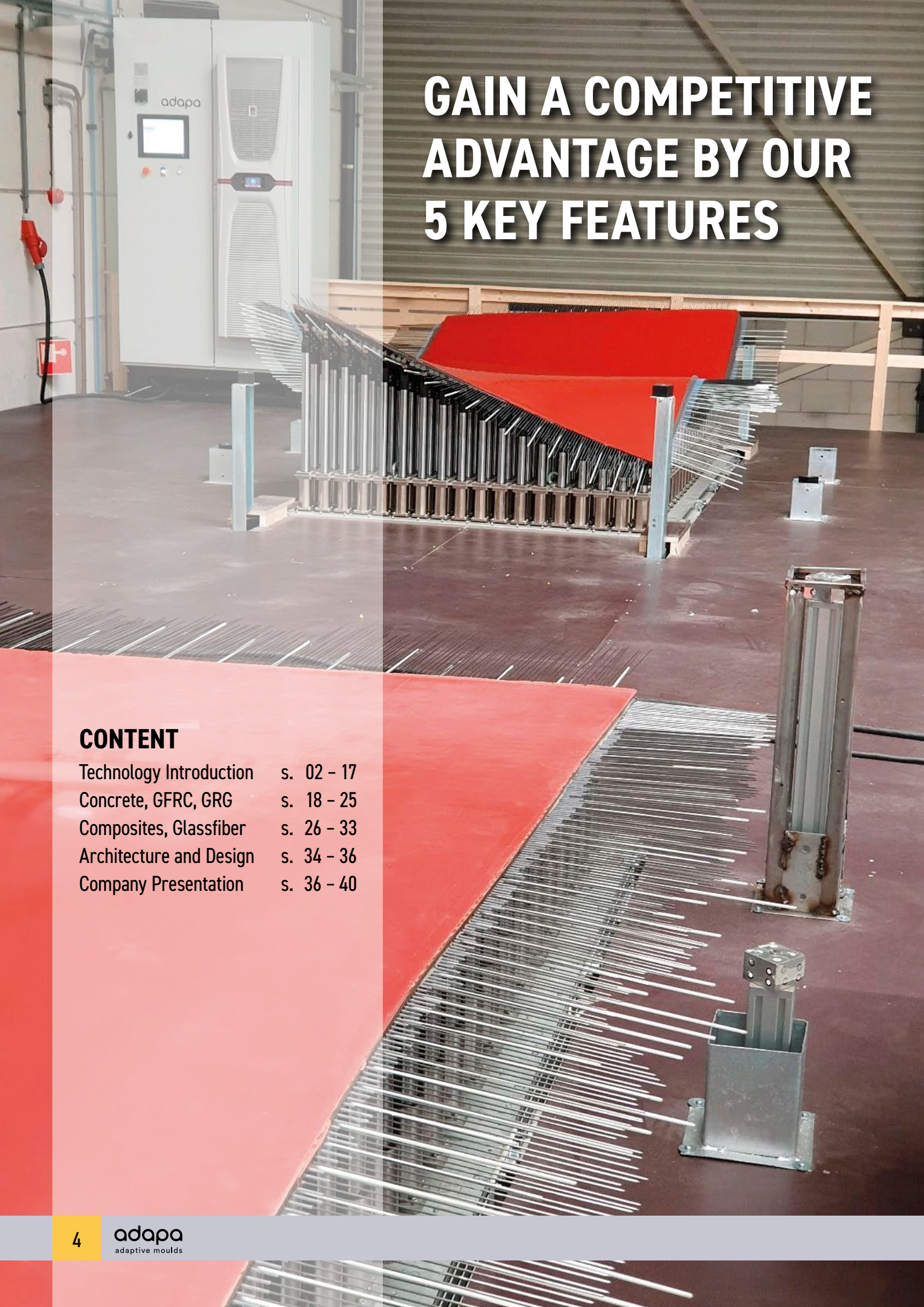
There is a rise in demand for curved organic design and architecture, only limited by the traditional way of thinking and perceived high cost of unique design manufacture.
Traditional thinking keeps us in the belief that uniformity is the only way to achieve fast and cost-effective manufacture.
The belief is that unique products or iconic architecture, is time consuming to manufacture and thus the cost exclusively high.
In a world where you can design and custom make – t-shirts, shoes or cars and 3D print products in your own home – it is time to set free the designers and architects that shape our experience of the future.
Technology of today is used to support all sorts of human activities. Software enhances the performance we used to do manually and the machines we operate are getting more and more intelligent.
Intelligent automation opens the possibility for manufacturing unique design and architecture at affordable cost in all industries.
Our adaptive moulds are intelligent and assist the fabricators in accuracy quality and anticipating material warp effects, while keeping an eye on its own mechanical performance.
Controlling the adaptive moulds are quite easy and based on the CAD design file. It is possible to change the desired shape of the final product any time, right up to the time of fabrication.
In many cases our adaptive technology is seen as the next step in automized manufacture of curved surfaces, allowing a substantial jump in fabrication capacity where present CNC cutting machines are used for smaller parts.
We are proud that our customers appreciate, is the 200 kg CO2-emission each m2 fabricated curved surface reduction, they achieve when shifting from polystyrene one-off moulds to our adaptive mould technology.
Adapa A/S is the market leading manufacturer of reconfigurable moulds for the fabrication of curved concrete and composite elements and panels and are pleased to work with a long range of architects, consultants, contractors, material suppliers and fabricators.
Our technology is patented, and our quality management system is ISO9001 certified.
We continuously expand the range of co-operative technologies that optimize fabrication of curved design, to empower free form design and architecture.

ISO 9001 Certification
BUREAU VERITAS

PATENTED
PATENTED
PATENTED

Since 2010 Adapa has cooperated with a range of material and fabrication experts, to assist architects, designers, advisors, and fabricators to benefit from a mature and proven adaptive mould technology that can shape curved designs.
The adaptive mould technology is a reconfigurable tool that can be used again and again, each time in different shapes.
Compared to using traditional moulds that only produce uniform products, our adaptive moulds favor uniqueness and empower creativity.

GAIN A COMPETITIVE ADVANTAGE BY OUR 5 KEY FEATURES



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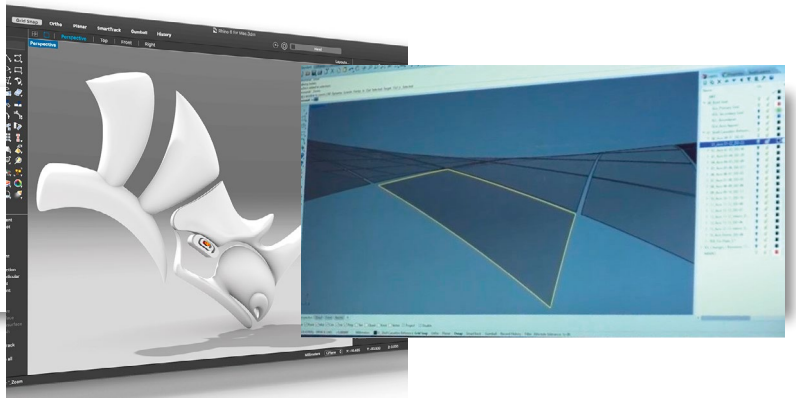
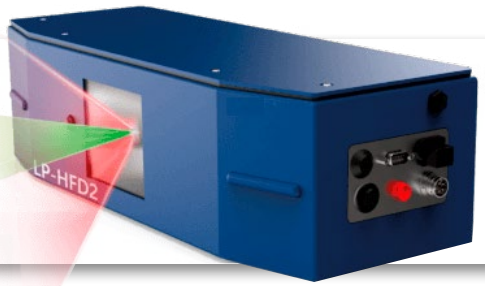
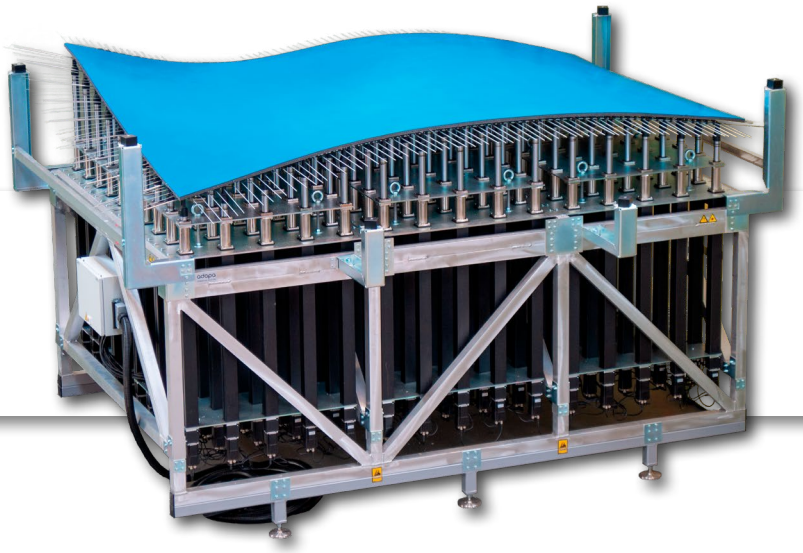
5 minutes from CAD file to curved surface





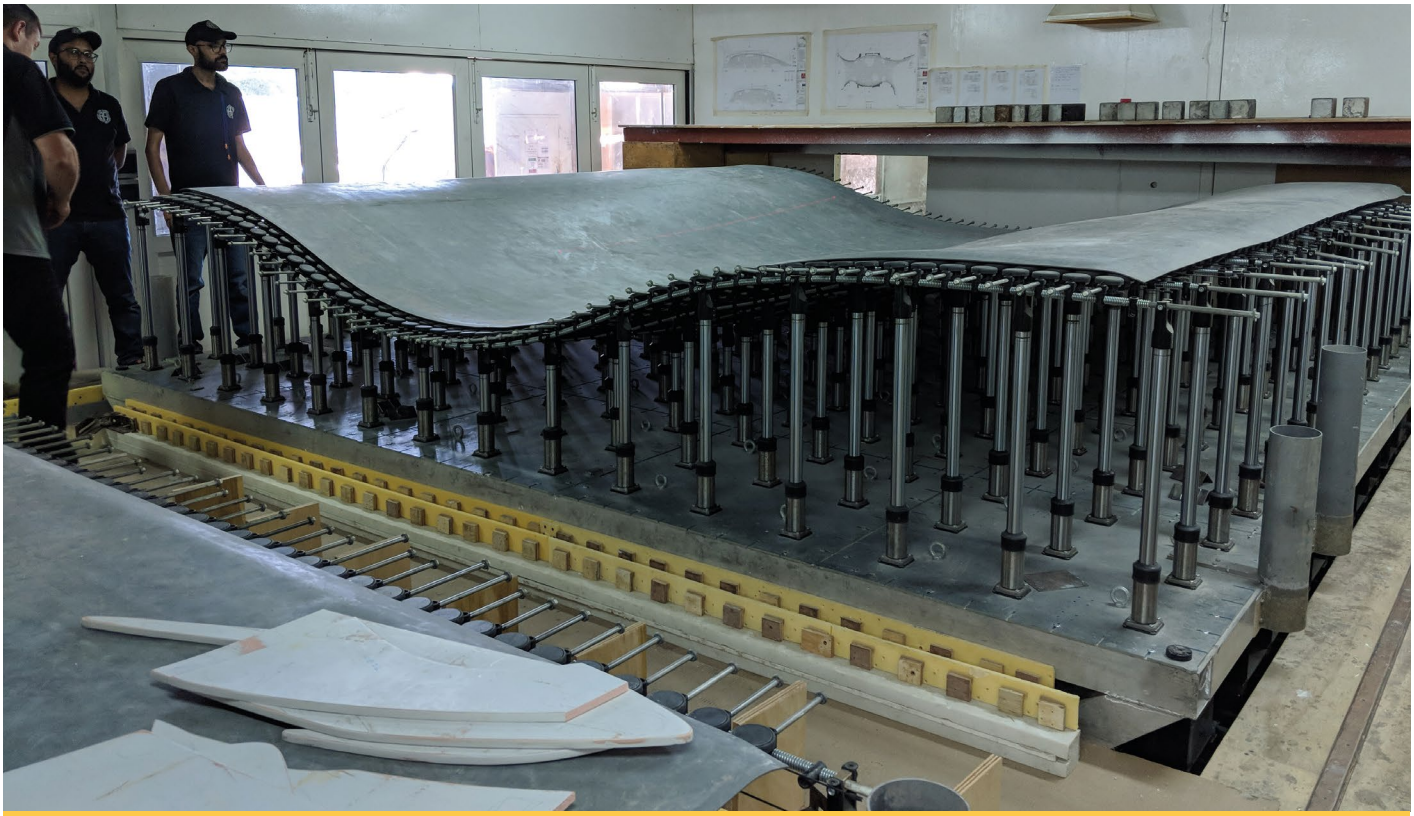
Multiple laser guided formwork possibilities



Tolerance within industry standards with anticipated warp effect programming

Easy HMI touch operation

Diagnostics of hardware performance and logfile documentation



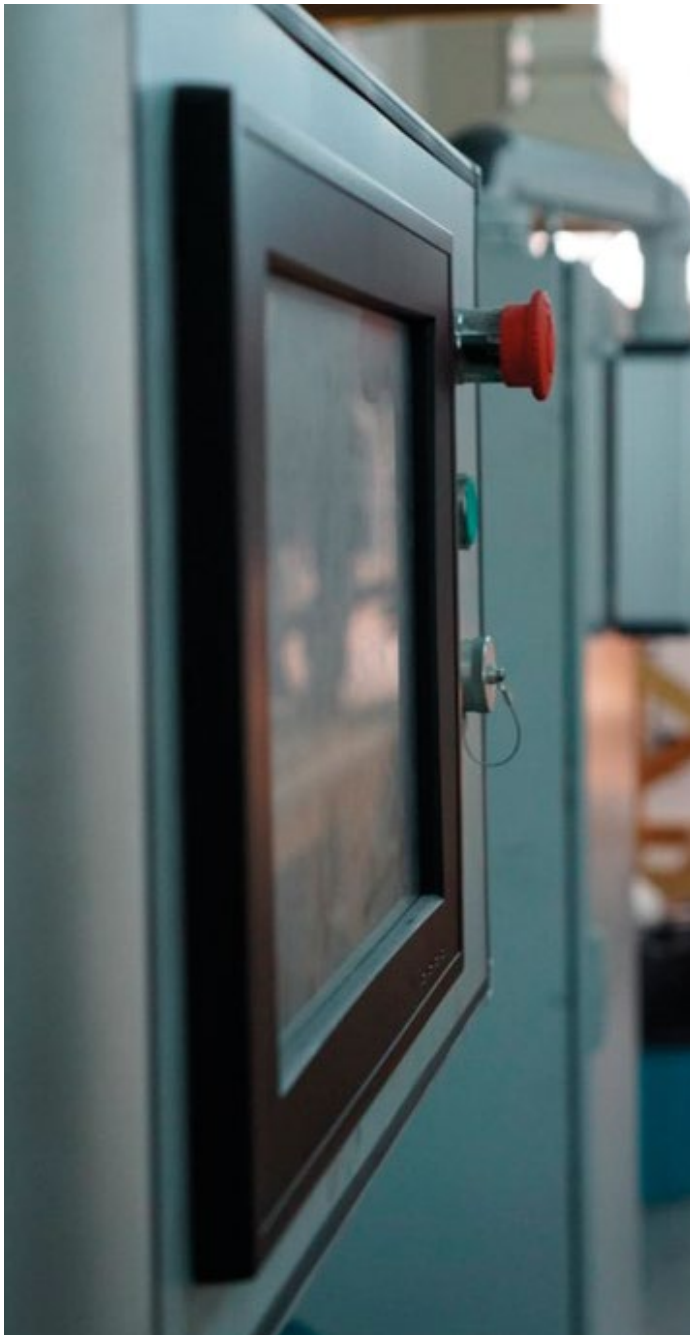
Easy and intuitive to use. One day of training and you are ready to fabricate.

Adaptive moulds that fit into standard shipment sizes can be set up with remote support from our engineers, while larger adaptive moulds are shipped in modules for final assembly in your facility.

The required electrical installation is a standard power input of 400 VAC 16A 5P connected to the control unit. The intuitive user interface enables easy surface calibration and during the initial shape test mechanical performance is automatically monitored by the embedded software.

Based on user preference for production management, the adaptive mould can either be handled as a stand-alone, network connected, or internet connected machine.

Plug and play with our engineers as remote support for adaptive moulds that can be shipped fully assembled



CUSTOMIZED SPECIFICATION AND INSTALLATION

YOUR REQUIREMENTS ARE USED TO SPECIFY THE SOLUTION

Based on your specific requirements we customize our adaptive moulds to support your fabrication demands and facility layout.

The required space for an adaptive mould capable of fabricating thousands of curved panels or elements is determined by the adaptive mould size, needed surrounding workspace and the laser height position.

Based on your specific materials and processes there more opportunities for installing collaborative technologies in connection to the adaptive mould to utilize the full benefit of automated process manufacture.

Built with the needs of architects and fabricators in mind, one adaptive moulds enables a scalable fabrication of thousands of uniquely curved panels or elements.

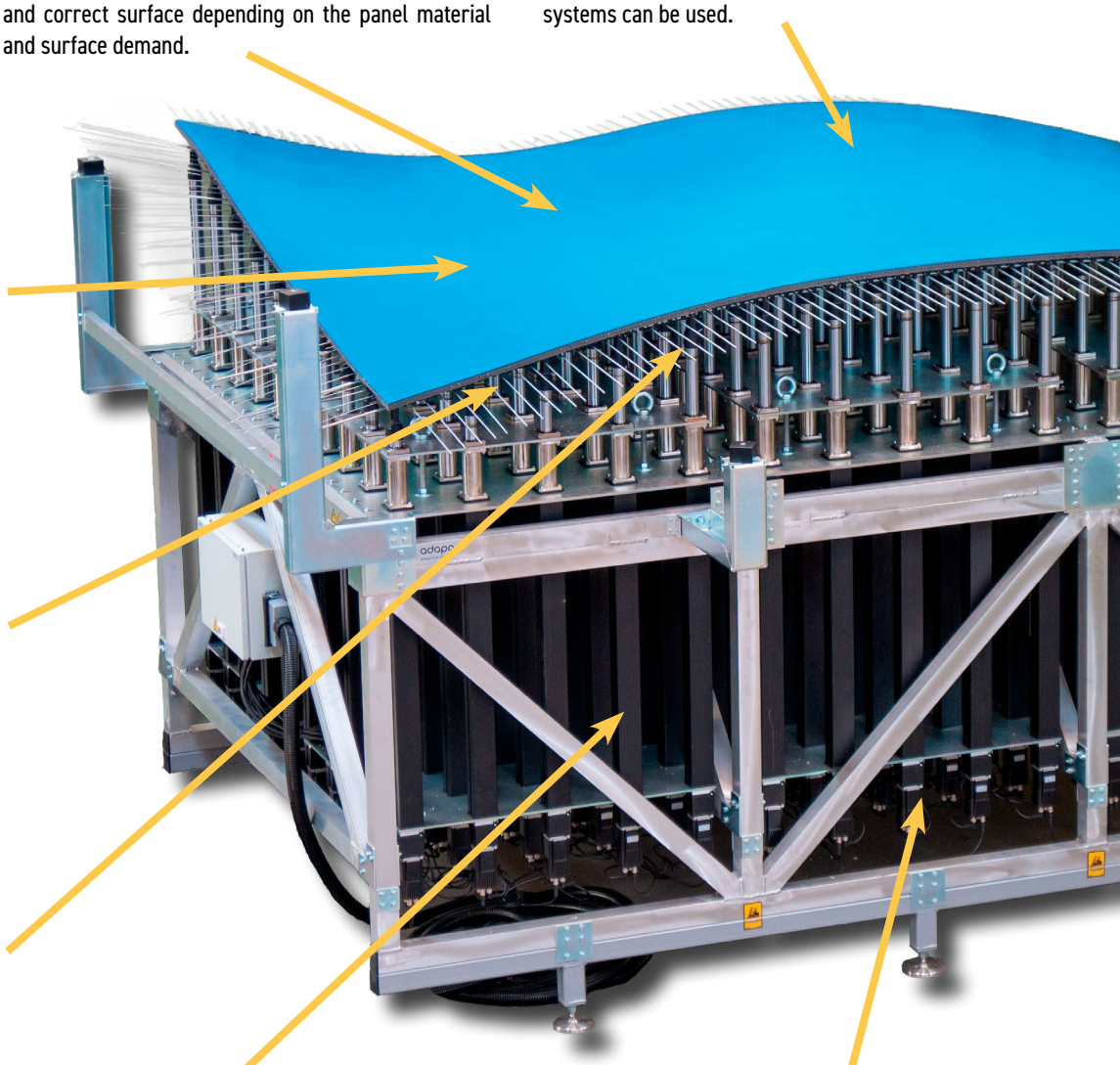
ADAPTIVE MOULD COMPONENTS

Moulding components
That shape the surface to be used for formwork

Protective silicone sheet
On top of the membrane a thin silicone sheet is placed, and may be held in place by vacuum, to reduce tear and wear of the membrane and to secure the most optimal and correct surface depending on the panel material and surface demand.

Casting sides and magnetic shuttering
On top of the adaptive mould casting sides of different types and styles can be used. Due to the magnetic properties of the membrane, custom magnetic shuttering systems can be used.

Silicon ferromagnetic composite membrane
A heavy 18 mm thick silicon ferromagnetic composite membrane serves as the initial mould surface. This part of the membrane either consist of glue-joined tiles that are practical and easy to distribute, handle and replace, or a full-size casted membrane.



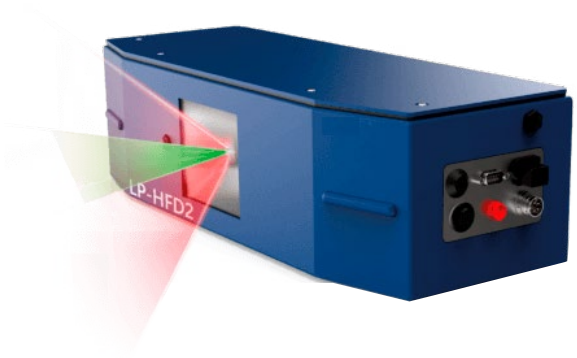
Membrane Supporting Magnets
Topping the rod system membrane supporting magnets are placed, to hold the membrane in place as the adaptive mould is moving into the desired curvature.

Flexible rod system
A system of mould type specific rods positioned by the fork joints and interconnected between rows and lines, is essential for accuracy and low tolerance in the final casting surface position.

Linear actuators
Linear actuators are powered by the stepper motors to bring the fork joints positioned at the top of each actuator, into the exact 3D position determined by the 3D shape in the Adapa Tools software.

Electrical Stepper Motors
Adapa designed Electrical Stepper Motors turn the adaptive mould into position. The motors are controlled by the Computer Aided Manufacturing (CAM) software in the Control Unit that communicate with PCB's placed in each individual stepper motor.

The robotic Adaptive Mould solution is divided into two main technology areas



3D laser
The casting sides can easily be placed using a 3D laser placed 3-5 meters above the adaptive mould. The laser also laser-guides correct placement of panels, ornaments, letters or alike to be placed on the casting surface.

Steering components For accurate 3D positioning of the mould surface

Software
Our own software Adapa Tools, is a Rhino plugin software that prepares the CAD files for the panel prior to fabrication. The software analyses and optimizes the design of each panel in accordance with the specific mould that is being used. The software supports files formats such as 3dm, iges, stl, stp, 3ds, dwg, etc.

Control unit
The 3D designs are transferred to the mould from the control unit, which acts as the central nervous system that manages mould operations and configurations.

General component description and specification

	COMPONENT	DESCRIPTION	CHOICE
SOFTWARE	**Adapa Tools**	Rhino plugin software for transfer of shapes from CAD to the Adaptive Mould.	License included in all adaptive moulds
	Rhinoceros for Windows	External software needed to operate Adapa Tools. Rhinoceros 3D Software for Windows and Mac www.rhino3d.com. Trial version for download available.	Needed 3rd party software
	Windows 10	Windows 10 is the operating system used for manual control on the HMI panel when using the adaptive mould. (Windows C, C#, WPF programmed)	Included in touch panel PC
LASER	**LP-HFD2 60° max angle**	The 3D Z-laser is adapted to AdapaTools soft ware, choice of projection angle available: Tolerance 0.2 mm/m Maximum focus range 14 meter Projection 2D, 3D, CAD, Circle, Cross, DOE, Line, Point Wavelength 520 nm, 638 nm Weight 7300 g Dimensions 500 x 200 x 141 mm Supply voltage 24 VDC Output power 14mW, 28mW, 7mW IP protection class IP67 Cube Holder V4.2 with Laser Reflector	Included in adaptive moulds with an active area larger than 1000 x 1000 mm
CONTROL UNITS	**Tablet Control**	Windows tablet (beskrivelse tbd)	For adaptive moulds less that 1000 x 1000 mm
	Small Control Cabinet	Plug and play cabinet with ventilator: Steel Cabinet DxWxH 400 x 800 x 973 Touch Panel PC 12,1"(2 GB RAM, Intel Atom Processor, SSD 32GB) CAM / HMI software Windows (C, c#, WPF) Com cables 5 mm x 5 meters Air vent cooling 450 m3 / h Movement Controller (PCB) Powersupply up to 3 x 24 V 125 A	For smaller and medium size adaptive moulds

EXPLANATION

AdapaTools is the application used for transferring panel shapes from CAD to the adaptive mould.
The software is a plugin to Rhino3D, an easy-to-use CAD program for curved shapes and geometries. With AdapaTools it is easy to select the panels of interest and verify the geometry for the tolerances of production. Optional production requirements can be added when working from AdapaTools. For example: The user is prompted to input which side of the panel should be facing the mould side, which lines the laser projection should include as visual guidance, the panel thickness, panel name, edge numbering, etc.

Rhinoceros is the CAD software with an API for Adapa Tools.
Creating panel shapes can be done in any CAD software, the file just needs to be converted into Rhino format, for Adapa Tools to exchange and process data in real time between the CAD software and the Windows software controlling the adaptive mould.

Windows is the software used for controlling the adaptive mould
Each adaptive mould contains a PC with Windows software that are operated through the HMI touch panel, or on small adaptive moulds a windows tablet. The computer contains a program for controlling the adaptive mould as well as the connected 3D laser.

LP-HFD2 Z-Laser guidance for easy positioning and formwork
This high-power laser projector with a fiber-coupled laser source offers the highest projection accuracy. It is optimized for displaying 2D and 3D projections. Presentation of CAD data is easily doable with the enclosed LPM software. Coupled with the laser projector, it can also be used as a multi-projection system.

The laser is IP65 protection class with high temperature stability. Cooling options such as a fan hose and water cooling are available for use at higher ambient temperatures. Ethernet is the typical data connection mode. In addition, communication via Profinet or a serial connection is possible.

The recommended projection angle for a specific adaptive mould depends on demand for accuracy and the available distance between maximum height of the adaptive mould and the maximum laser position height that may be limited by the facility ceiling height.

Tablet Control for easy mobile operation of adaptive moulds
The 10.1" Windows tablet is an ideal HMI solution for small adaptive moulds.
The electrical and steering components are built into the adaptive mould, allowing for wireless control through the Windows tablet. For showcases and purposes alike, the hand-held tablet is ideal to share the adaptive mould ease-of-control experience.

Small Control Cabinet for easy operation of adaptive moulds
Ideal cabinet for smaller and medium size adaptive moulds that can hold up to 3 PSU's each 24V 125A. The cabinet is easy to re-locate and only requires two power cable connections. Air ventilation makes it operational in temperatures up to 35° C. The touch screen is visible in daylight, artificial light and under dark conditions, and easy to clean between operator shifts.

General component description and specification

		DESCRIPTION	CHOICE
CONTROL UNITS	**Large Control Cabinet**	Plug and play cabinet with air condition: Steel Cabinet DxWxH 400 x 1.200 x 2.000 mm Touch Panel PC 12,1"(4 GB RAM, i3 2,4 GHz dual core, 32 GB SSD) CAM / HMI software Windows (C, c#, WPF) Com cables 5 mm x 5 meters Air condition cooling 1.600 W Movement Controller (PCB) Powersupply up to 10 x 24 V 125 A	For large size adaptive moulds
STEPPER MOTORS	**Stepper Motor 600, 1000 or 2000 Newton**	Adapa developed electrical stepper motor: Max thrust (push/pull) 60, 100 or 200 kg Ingress Protection IP54 Max room temperature 50° C	Dependent of payload demands and density distribution of actuators.
ACTUATORS	**Linear Actuators 200 - 1000 mm**	Adapa developed linear actuators: Standard Travel range 200-1000mm Custom Travel range >1000 mm with increase in tolerance: Max vertical velocity 5 mm/s Max thrust categories 60kg, 100kg and 200kg Ingress Protection IP54	Dependent on type and customization
ROD SYSTEM	**Flexible rod system**	Mechanical net for adaptive moulds that consists of Primary rods, Secondary rods: Steel rods Ø12 - 6 mm CFRP rods Ø3 - 1.8 mm	Double curved moulds, dependent on type and customization
	Pipe system	Mechanical system for single curved adaptive moulds that consists of Primary Pipe rods: Steel pipe 88.9 x 5.6 mm	Single curved moulds, dependent on type and customization

EXPLANATION

Large Control Cabinet easy operation of adaptive moulds
Ideal cabinet for larger adaptive moulds, that can hold up to 10 PCU's each 24V 125A. The cabinet is best placed wall sided in stationary production setup.
The touch screen is visible in daylight, artificial light and under dark conditions, and easy to clean between operator shifts.
The air condition makes it operational in temperatures up to 55° C.

Electrical Stepper Motors for computer controlled accurate positioning
The Adapa designed stepper motors are controlled by the Computer Aided Manufacturing (CAM) software in the Control Unit that communicate with PCB's placed in each individual stepper motor and turn them into position.
The stepper motors are in the low voltage range. They use 24V for the movement of the motor and 12V for the control.
There are three categories of stepper motors used, depending on the adaptive mould type and application, with push/pull of 600, 1000 or 200 Newton.
The stepper motors and actuator bodies are IP54 rated and rarely malfunctions when motors are protected against overheating in extreme hot conditions.

Linear Actuators with customized travel length
A series of Adapa designed linear actuators are responsible generating the shape of the surface. They are placed in Unicells where the actuators are a middle point between the electrical motor system and the membrane support system with magnets, rods, and membrane.
The actuators can be customized to any travel size between 200 and 1.000 mm and stay within the tolerances specified on our different adaptive mould types.Actuator travel height above 1.000 mm can be delivered according to customer request, with some effect on the +/- tolerance on the adaptive mould surface.The linear actuators are self-locking, meaning that the motors can be safely turned off while in shape and remain in locked position.

Flexible rod system for double curved adaptive moulds
The rod system is attached to the linear actuators by fork-joints and recreates the digitally created surface into a physical shape on the adaptive mould.
Magnets attached to the top of the flexible rod system, are there to force the membrane on top of them to take the shape according to the rod system position, enabling the user to have a smooth curved surface to work on.

Pipe system for single curved adaptive moulds
On single curved moulds a pipe system is attached to the linear actuators to recreate the digitally created surface into a physical shape on the adaptive mould. The metal sheet surface is attached directly onto the pipe system, to create the shape.

General component description and specification

	COMPONENT	DESCRIPTION	CHOICE
MEMBRANE SUPPORTING MAGNETS	**Magnet Cups**	Magnets for membrane support: Magnet cup diameter 50 – 15 mm Material NdFeB or Ferrite Coating NiCuNi	Double curved moulds, dependent on type and customization
MEMBRANES	**Grey composite membrane tiles**	Ferromagnetic membrane made by connected Adapa casted tiles to the full adaptive mould size: Shore 55A or 40A Tile size 1 x 1 meter Weight 40 – 50 kg/m2 Surface roughness Ra[µm] 1.6	Double curved moulds, dependent on type and customization
	Blue composite membrane	Ferromagnetic membrane full size casted by Adapa: Shore 40A Maximum size 2 x 3 meter Weight 40 kg/m2 Surface roughness Ra[µm] 1.6	Double curved moulds, dependent on type and customization
PROTECTIVE SHEETS	**Protective silicone sheets**	Silicone sheet made by connected Adapa casted tiles to he full adaptive mould size: Shore 70A to 40A Size 3.6 meter x 5 or 3mm Weight 15 – 24 kg/m2 Surface roughness Ra[µm] 1.6	Dependent on type and customization
FORMING AND SHAPING	**Application and use**	The solutions are described under each following application segment.	Material and process specific.

EXPLANATION

Magnet Cups supporting and holding the membrane
Magnets vary in material, strength, and size in relation to the specific adaptive mould type.
The magnets are quite powerful and potentially hazardous, where it is necessary to take precaution before coming into contact.
The magnetic properties are used to support and hold the ferromagnetic membrane in the shape created by the flexible rod system.
The magnets must be strong enough to make the ferromagnetic membrane follow the shape, and weak enough to allow it to slide across the Membrane Support System without stretching the Membrane where tolerances could be lost.

Grey ferromagnetic composite membrane tiles for heavy use
Made by Adapa in a unique casting process of selected raw materials that is essential for achieving high quality and long-life.
If protected and maintained well, the membrane will endure the manufacture of thousands of uniquely curved products.
Should the membrane be damaged to a point not reparable using silicone glue, the tile-module construction will reduce the replacement cost.
Thus, often used in heavy casting situations like concrete.

Blue full size composite membrane for high demanding surfaces
Made by Adapa in a unique casting process of selected raw materials that is essential for achieving high quality and long-life.
If protected and maintained well, the membrane will endure the manufacture of thousands of uniquely curved products.
Should the membrane be surface damaged it can be repaired using silicone glue. The full-size casted membrane ensures a smooth casting surface, often used for composites with demand for high surface quality.

Protective Silicone Sheets to reduce tear and wear
On top of the membrane a thin silicone sheet is placed, to reduce tear and wear of the membrane and to secure the most optimal and correct surface depending on the panel material and surface demand.
The protective silicone sheet may be held in place by vacuum in case of low curvature radius shapes.
It is possible to source you own protective sheets, based on individual preference.

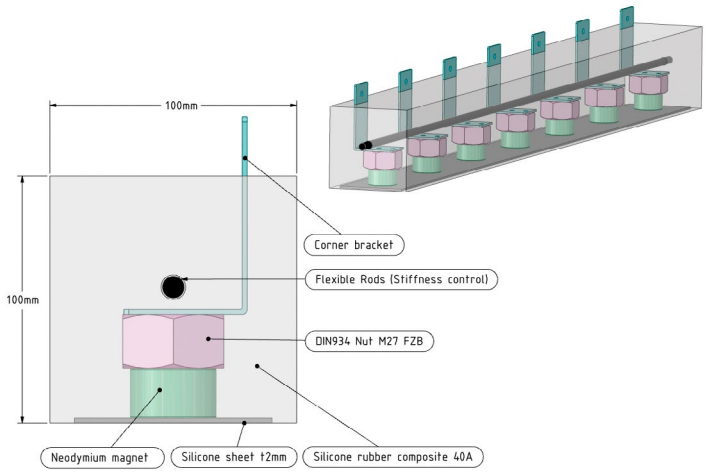
Forming and Shaping accessories for formwork
A large variety of products and technologies for formwork and material shaping is available.
In addition to your own sourcing, Adapa partners can supply products and collaborative technologies like; topliners with patterns, vacuum and infusion, heating and cooling, spay-guns and alike.

Reusable accessories for formwork

Magnetic Silicone Casting Sides 100 x 100 mm – for 90° edge returns

The 100×100 mm magnetic silicone casting side is mostly used in glass fiber casting or in situations where composite panel casting demand for high edge-sides to be casted. The weight makes it maneuverable by two persons when positioning.
The cast-individual need for stiffness control of the side can be regulated by inserting different rod-types into the center tube of the silicone casting side.
The height can be adjusted by fixing extension sides on brackets on top of the silicone casting side. Length according to customer request.

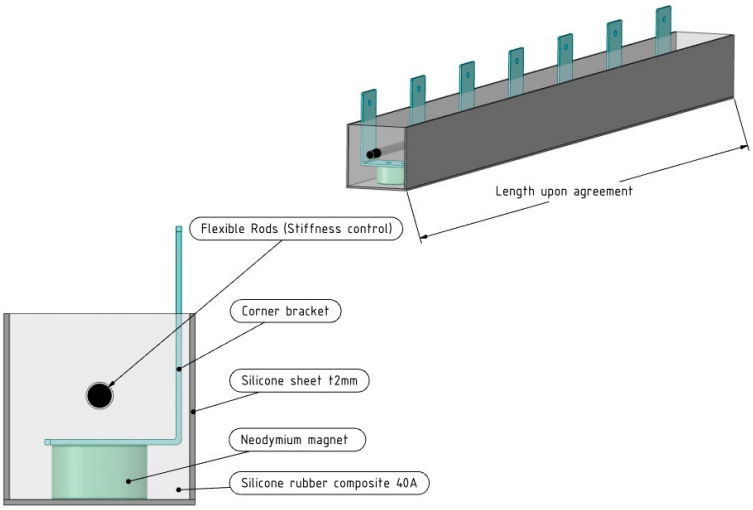
Curvature radius minimum 900 mm
Stiffness Control Flexible Rod (selected to fit mould curvature)
Length According to customer need
(standard maximum of 6 meters)
Height Extension possible via corner bracket
Extension bracket fixture Hexagon nut DIN 934 M27 FZB
Magnetic strength Horizontal 1.130 kg / m2
Weight each running meter 16 kg



Magnetic Silicone Casting Side 70 x 70 mm – for 90° edge returns

The 70×70 mm magnetic silicone casting side is mostly used in composite casting situations where panel thickness is low and there is only little demand for edge-sides to be casted. The weight makes it easy maneuverable when positioning.
The cast-individual need for stiffness control of the side can be regulated by inserting different rod-types into the center tube of the silicone casting side.
The height can be adjusted by fixing extension sides on brackets on top of the silicone casting side. Length according to customer request.

Curvature radius minimum 600 mm
Stiffness Control Flexible Rod (selected to fit mould curvature)
Length According to customer need
(standard maximum of 6 meters)
Height Extension possible via corner bracket
Extension bracket fixture Hexagon nut DIN 934 M27 FZB
Magnetic strength Horizontal 1.130 kg / m2
Weight each running meter 8.5 kg



Customized Silicone Casting Sides

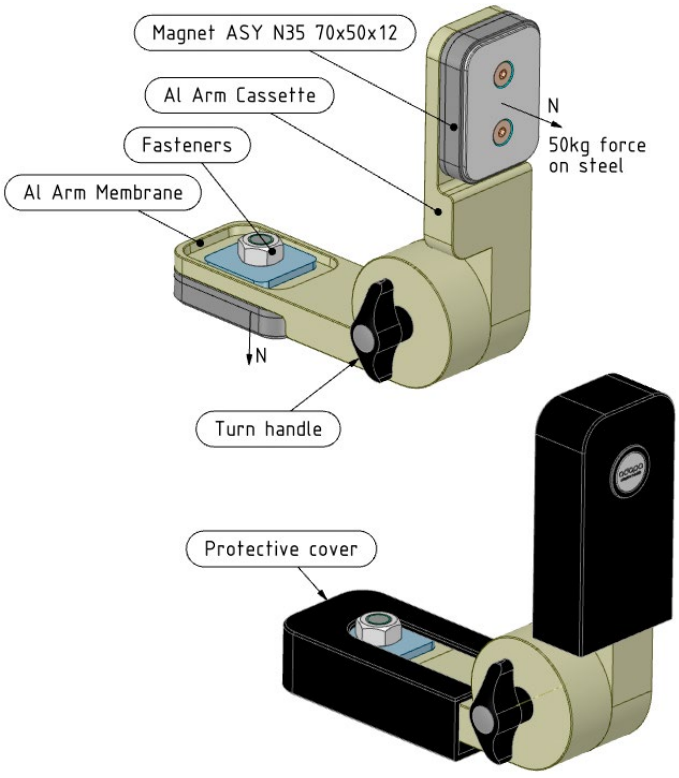
We offer our customers the ability to design project specific casting sides, and allow for your own manufacture based on our knowledge.

Specification according to customer request

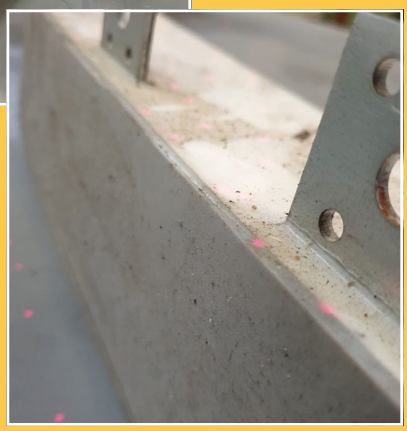
Adjustable Shuttering Magnets – for adjustable angular support

The magnetic angular support serves as an adjustable supporting element in a shuttering system for casting on adaptive moulds.
Typically, it is used to support curved wooden (or alike) casting sides that are CNC cut based on the panel 3D files.
A powerful magnet is used to fix it to the casting membrane, and it can be fixed to casting side using the standard mounted magnet or customized solutions.
The magnetic angular support is adjustable device that can be set at any angle between 20 and 160 degrees and locked in position with a handle installed on its side.

Curvature radius minimum 1800 mm
Magnetic strength Vertical 100 kg on adaptive mould membrane, 50 kg on steel
Magnetic strength Horizontal depending on curvature, side angle etc.
Casting height 20 cm, recommended minimum distance 30 cm
Casting height 10 cm, recommended minimum distance 50 cm
Weight each 1,3 kg



WE CUSTOMIZE TO YOUR REQUEST OR SUPPORT YOU IN OWN MANUFACTURE OF SILICONE EDGE RETURNS



Adaptive Moulds for the Concrete Industry

An intelligent tool for competitive advantages through automated manufacturing

THE ADAPTIVE MOULD FOR PRECAST CONCRETE, HPC, GFRC AND GRG ENABLES MANUFACTURING COMPANIES TO PRODUCE LOW-REPETITION CURVED PANELS FASTER, AFFORDABLY AND MORE SUSTAINABLY THAN ALTERNATIVE TECHNIQUES.

Enabling high volume of uniquely curved precast concrete in large scale projects

Limak produced 36.964 reinforced precast shell cassettes on just 85 adaptive moulds with a daily output of up to 160 pcs a day.

13.000 unique panel geometries were designed by Fosters + Partners in the iconic architecture of Kuwait International Airport Terminal 2.

If using traditional CNC milling to create 160 one-off moulds each day, there should have been used a minimum of 300 CNC milling machines. Thus, a facility size difficult to manage and a waste situation impossible to accept.

Besides enabling the construction of the curved architecture, the mould cost each m2 was reduced by the adaptive moulds to a level not far from doing flat precast.

The adaptive moulds stood the test in the desert in Kuwait, enduring high temperatures and dusty conditions and yet still supporting the highly automated casting process.

"Complex concrete megastructures can be built on a large scale even within tight constraints with regard to time and budget"

Fabricate 2020

Compared to traditional one-off moulds

- **5 times less expensive**
- **7 times reduction in facility space**
- **150,000 m^3 or 4,500 Ton polystyrene saved**
- **31,000 Ton CO_2 emission saved**

The co_2 emission saved by adaptive moulds on the Terminal 2 construction, equals the equivalence of a full-grown forest for 4 years on the full 37.7 Km^2 area of Kuwait International Airport

adapa.dk

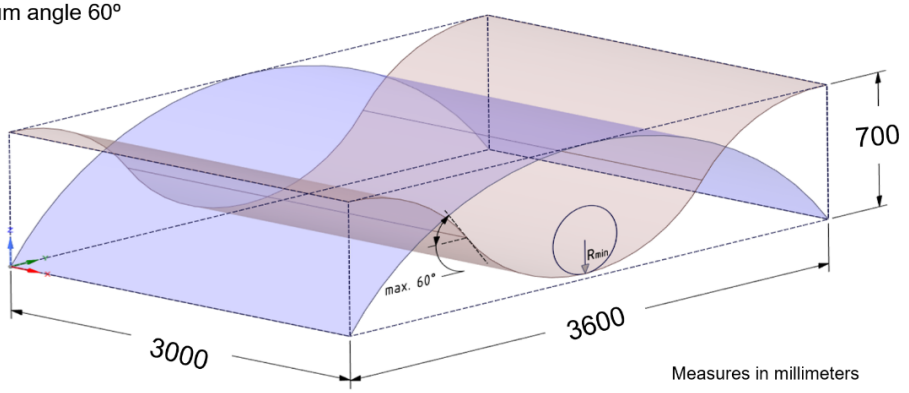
Adaptive mould types for manufacture of curved PRECAST CONCRETE, HPC ,GFRC and GRG

S300 Heavy – ideal for Concrete and HPC with single curved geometry – Minimum Curvature Radius 3500 mm

Typical size Bounding Box Length 3600 mm x Width 3000 mm x Height 700 mm

Limitations inside Bounding Box:

Minimum curvature radius 3500 mm
Maximum angle 60°

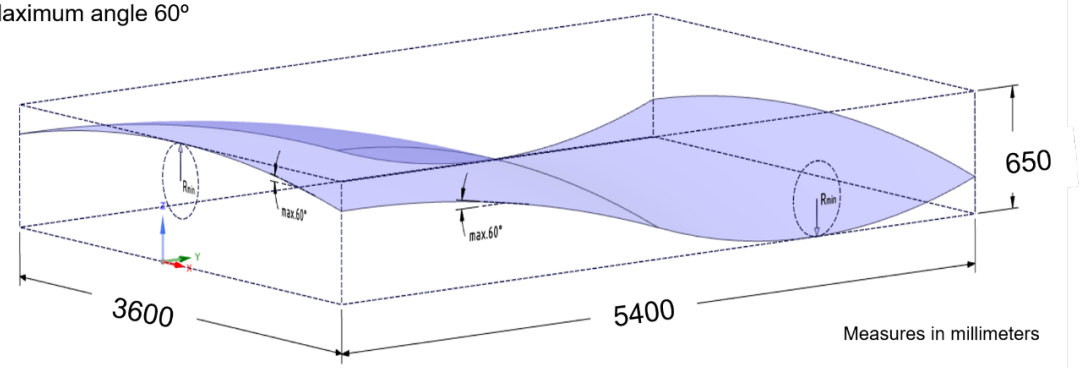


D300 Heavy – ideal for Concrete and HPC with double curved geometry – Minimum Curvature Radius 3500 mm

Typical size Bounding Box Length 5400 mm x Width 3600 mm x Height 650 mm

Limitations inside Bounding Box:

Minimum curvature radius 3500 mm
Maximum angle 60°

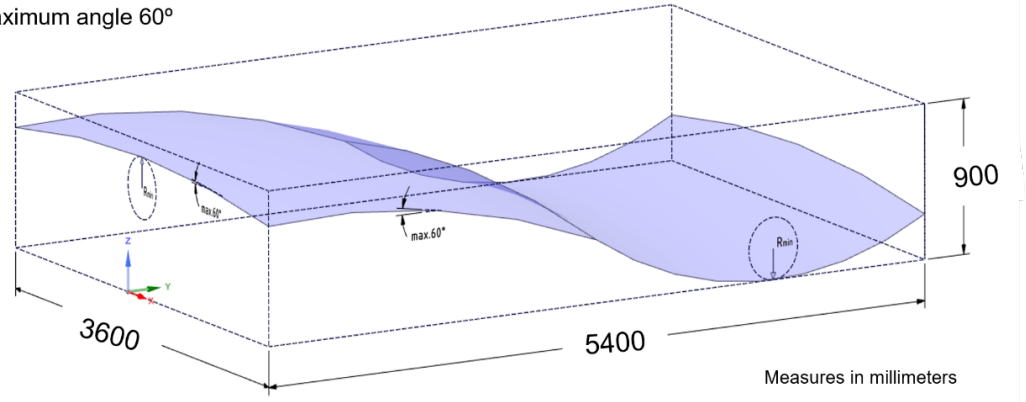


D300 – ideal for GFRC and GRG with double curved geometry – Minimum Curvature Radius 1800 mm

Typical size Bounding Box Length 5400 mm x Width 3600 mm x Height 900 mm

Limitations inside Bounding Box:

Minimum curvature radius 1800 mm
Maximum angle 60°



Advantages of computer aided manufacture on our adaptive moulds

Fast - One mould can take multiple shapes, and it can do so within minutes. This means that you have:

- ✓ The Possibility to fabricate different materials and designs with a single mould
- ✓ No waiting time for tooling
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Affordable - The Adaptive Mould eliminates the need for manufacturing unique tooling for every panel, as you have:

- ✓ Minimal tooling costs
- ✓ Reduced space requirements in your production setup
- ✓ Shorter production time

Sustainable - The Adaptive Mould significantly reduces your potential waste of disposable moulds, as you have:

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Multi Stage Forming - The flexible properties of the Adaptive Mould allow for multi-stage forming, including a process such as the following:

- ✓ Lay-up surface layer in flat stage
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- ✓ Low mould surface tolerances
- ✓ Guidance by accurate 3D laser
- ✓ Guided positioning of inlays, brackets and fixtures

Collaborative Technologies - The Adaptive Mould is designed to handle surface temperatures up to 200^{o} C and collaborate with several technologies:

- ✓ Magnetic silicon sides and shuttering for panel edge precision
- ✓ Top liners for patterns or inlays
- ✓ Spray gun and heating mats
- ✓ Robotic lay-up or post processes

We support you in your preference for customized formwork solutions

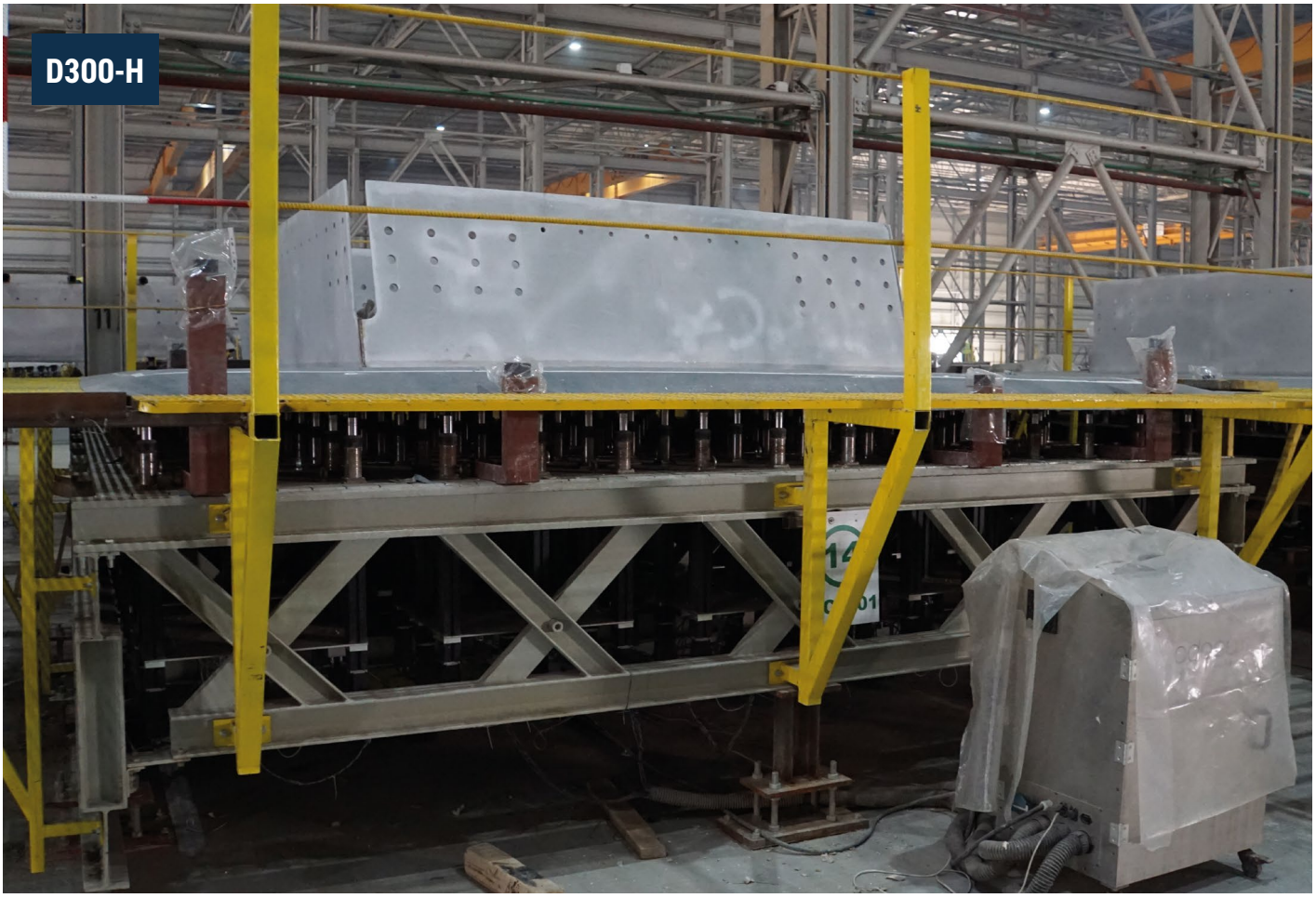
Adapa support you in design and manufacture of customized formwork solutions according to your request and your preference in manufacture and purchase. We support you by offering:

- ✓ Full-service design and manufacture on your request
- ✓ Provide sub-supplier information for your purchase department
- ✓ Deliver drawings and manufacture specification for you own manufacture

Technical Data for Double Curved Adaptive Mould Types for Precast Concrete, HPC, GFRC and GRG

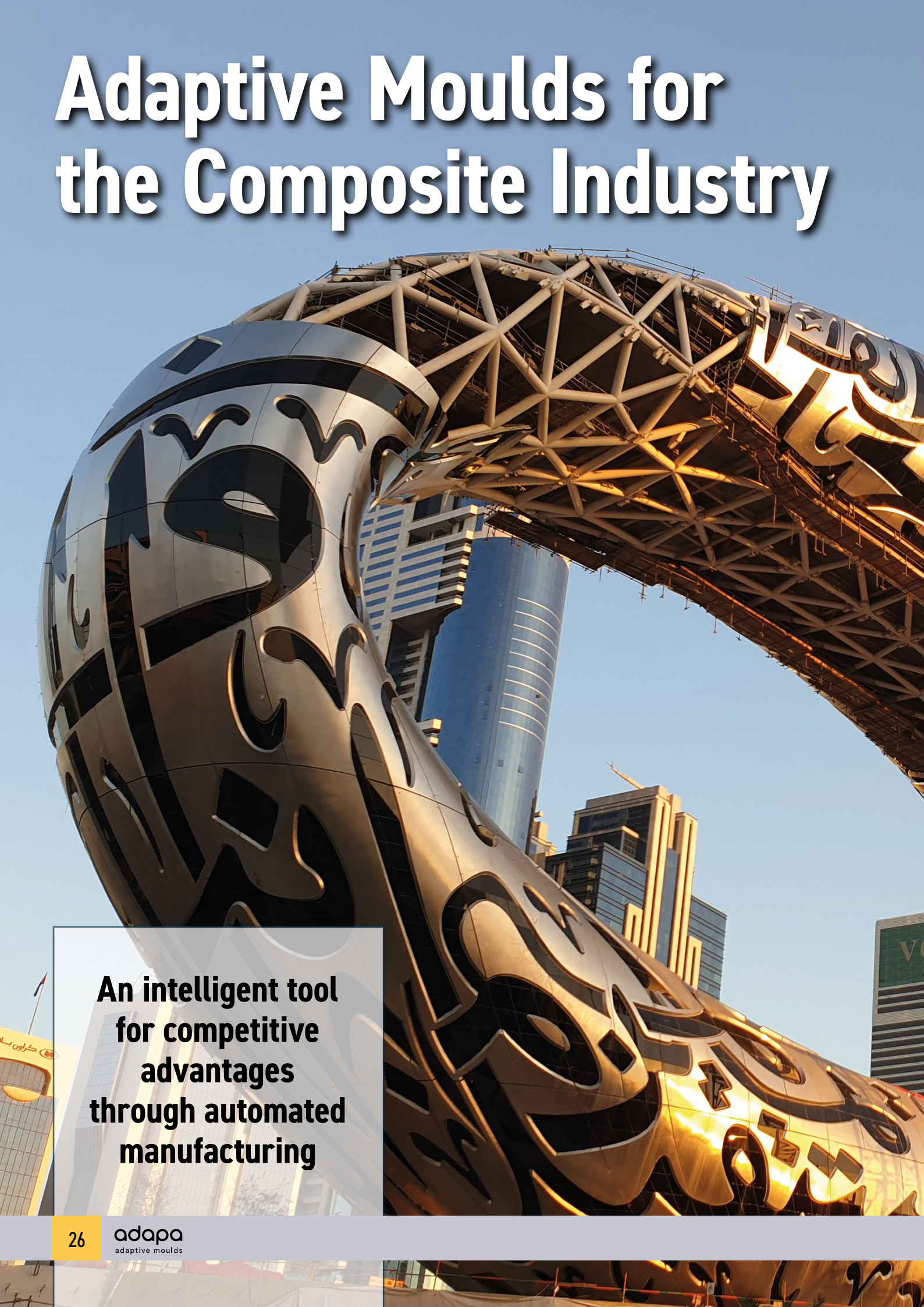
Technical Data		Single Curved	Double Curved	
		S300	D300-H	D300
Features Double Curved Adaptive Moulds				
Minimum curvature radius	mm	3500	3500	1800
Maximum casting area	mm	7500 x 6000 (1500 x 300 modules)	9000 x 9000	5400 x 3600
Maximum casting height (actuator travel)	mm	700 (extendable to 1000)	700 (extendable to 1000)	1000
Maximum payload	Kg/m²	1000	1000	225
Surface Tolerance	+/- mm	3.0	3.0	2.5
Motors and Actuators				
Actuator Density / Distance	mm	1500 x 300	300 x 300	300 x 300
Stepper motor Force each	Newton	2000	2000	2000
Stepper motor Watts each	Watt	60	60	60
Stepper motor Travel speed	mm/min	300	300	300
Rod system				
Steel rod Ø	mm	88.9 x 5.6 (Steel Pipe)	12	10
CFRP Alignment rod Ø	mm	-	3.0	2.0
Magnet Cup Diameter	mm	-	50	25
Magnet Cup Density	Pcs/m²	-	280	550
Silicone Ferromagnetic Composite Membrane 1 x 1 m				
Magnetic Silicone Composite	Shore	4 (Steel Plate)	55A	55A
Thickness	mm	4	18	18
Weight	kg/ m²	32	40	40
Surface Roughness	Ra[µm]	3.6	1.6	1.6
Magnetic Surface Pulling Force	Newton	150	18	18
Protective Silicone Sheet 3.6 m				
Thickness	mm	5	5	3
Weight	kg/ m²	24	24	15
Surface roughness	Ra[µm]	1.6	1.6	1.6

Magnetic surface properties, are defined by a pulling force created between a standard NdFeB DIA25x10 N38 magnet and the silicone composite surface



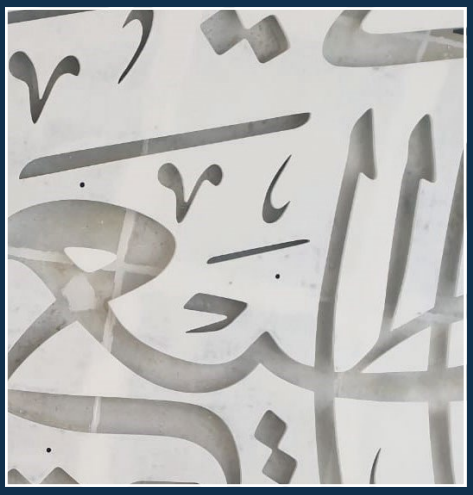
Examples of mould types

Adaptive Moulds for the Composite Industry



An intelligent tool for competitive advantages through automated manufacturing

The Adaptive Mould for Composites, Thermoplastic, Infusion and Glass fiber enables manufacturing companies to produce low-repetition curved panels faster, affordably and more sustainably than alternative techniques.



Enabling high volume of uniquely curved glass fiber panels in large scale projects

Advanced Fibreglass Industries produced 3.500 m2 curved glass fiber composite for the internal façade on Museum of the Future on only 3 adaptive moulds.
230 individual curved panels with individual calligraphy recess pattern were manufactured within +/- 2 mm tolerance of the 3D model for this iconic architecture designed by Killa Design.
If using traditional CNC milling to create 230 one-off moulds and finish the production within same time frame, there should have been used a minimum of 12 CNC milling machines. Thus, a facility size difficult to manage and a waste situation impossible to accept.

Besides enabling the construction of the curved architecture, the mould cost each m2 was reduced by the adaptive moulds to an affordable level.

The adaptive moulds stood the test demonstrating the importance of rapid curved surface and the ease of laser guided mould work, reducing facility space, manpower and waste.

"The future belongs to those who can imagine it, design it, and execute it. It isn't something you await, but rather create."

Prime Minister of UAE,
Shiekh Mohammed bin Rashid Al Maktoum

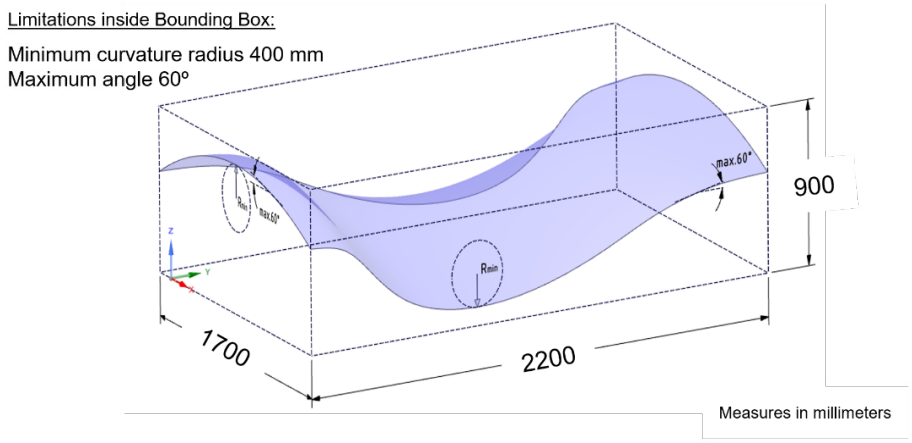
Compared to traditional one-off moulds
- **4 times less expensive**
- **5 times reduction in facility space**
- **1,750 m^3 or 26 Ton polystyrene saved**
- **181 Ton CO_2 emission saved**

Adapa's adaptive moulds were used for the interior of Museum of The Future and which supported the desire for reduction in waste and CO^2 emission.

Adaptive mould types for manufacture of curved GLASS FIBER, COMPOSITES and THERMOPLASTICS

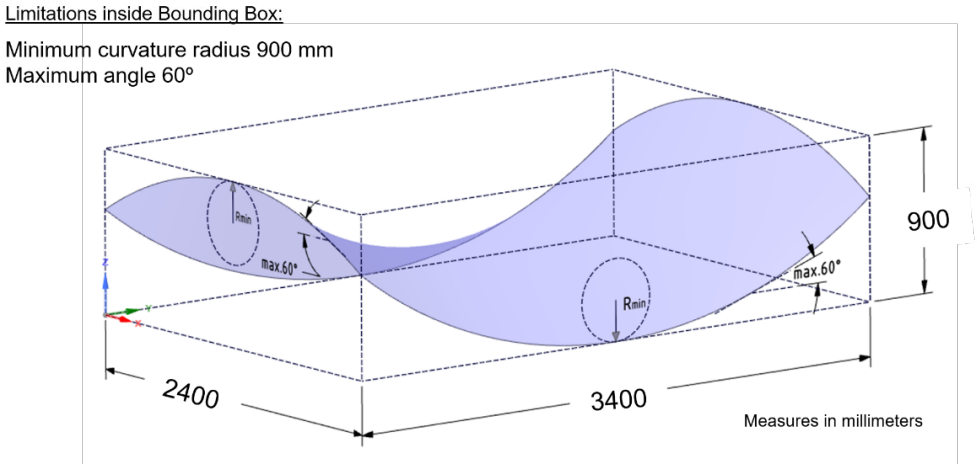
D100 – ideal for Composites and Thermoplastics with double curved geometry

Typical size Bounding Box Length 2200 mm x Width 1700 mm x Height 900 mm



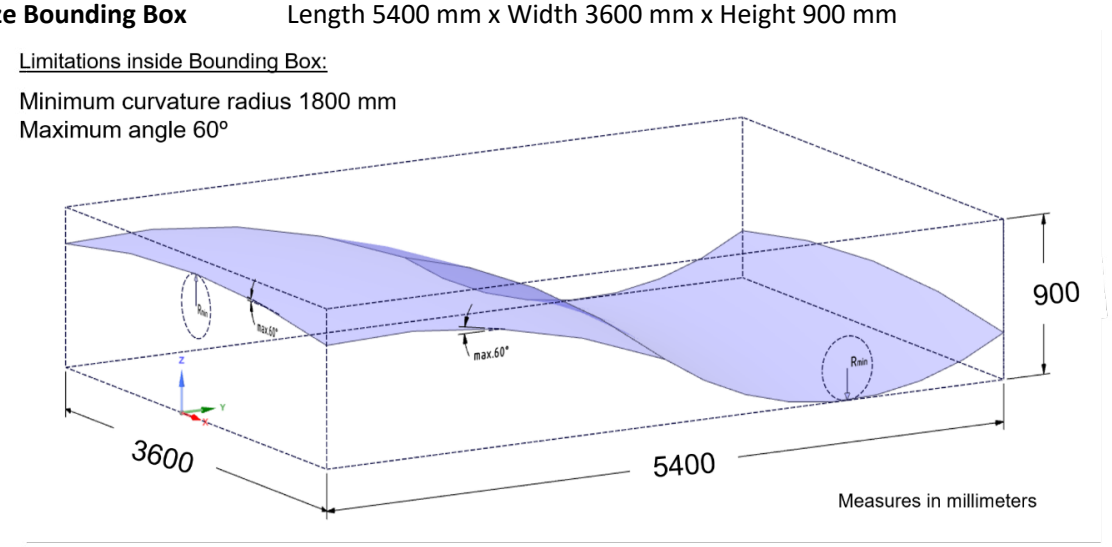
D200 – ideal for Composites and Thermoplastics with double curved geometry

Typical size Bounding Box Length 3400 mm x Width 2400 mm x Height 900 mm



D300 – ideal for Glass Fiber and Composites with double curved geometry

Typical size Bounding Box Length 5400 mm x Width 3600 mm x Height 900 mm



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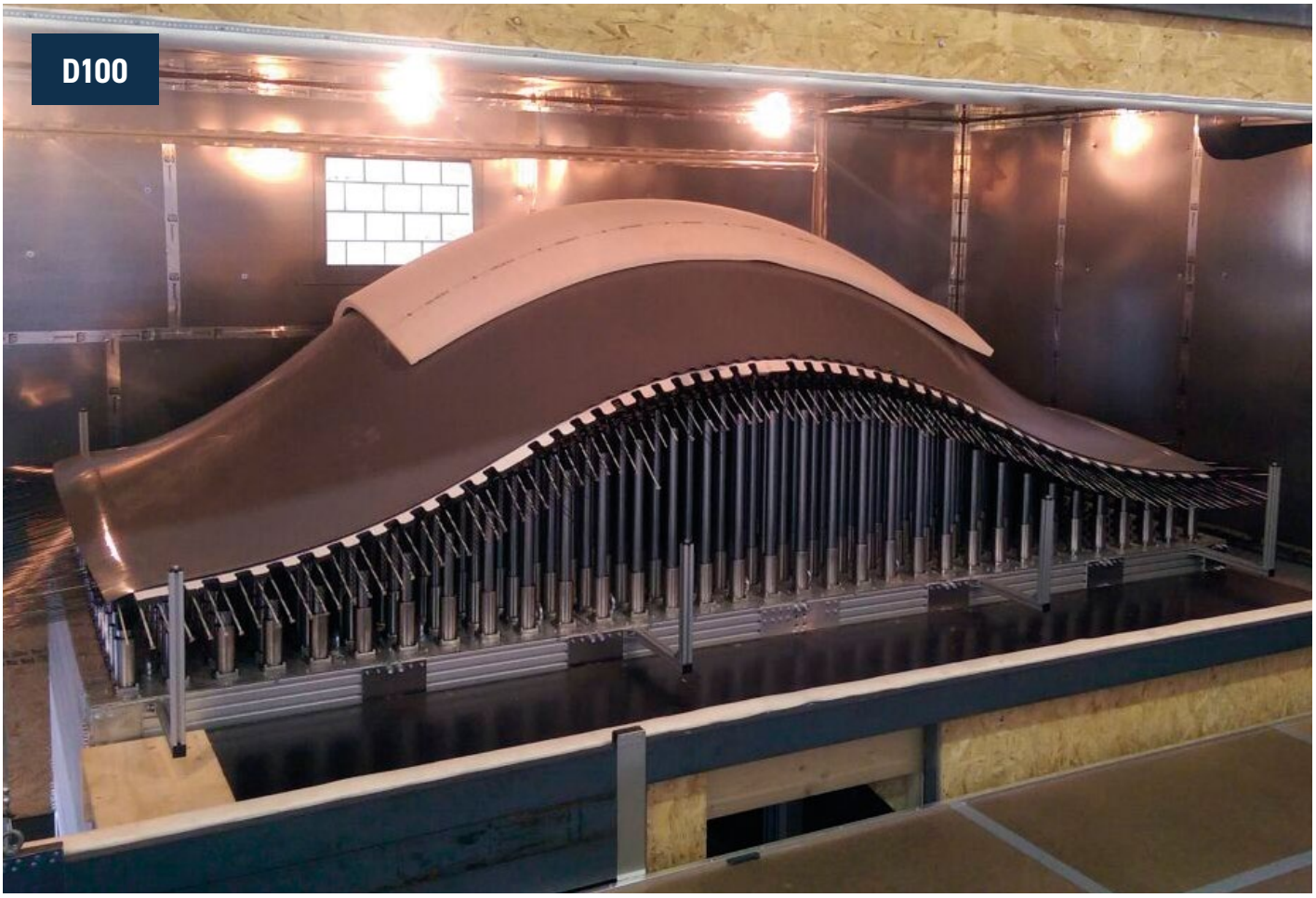
- ✓ Deliver drawings and manufacture specification for you own manufacture

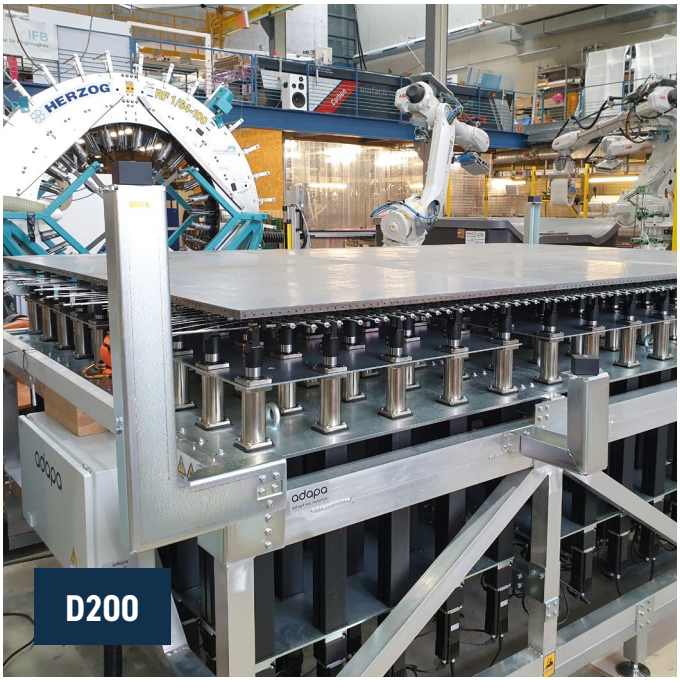
Technical Data for Double Curved Adaptive Mould Types for Glass Fiber, Composites and Thermoplastics

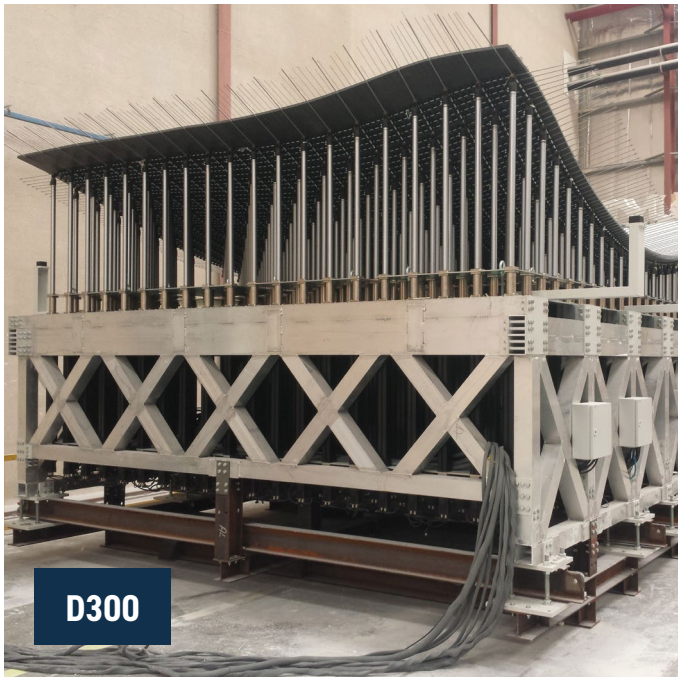
Technical Data		Double Curved		
		D300	D200	D100
Features Double Curved Adaptive Moulds				
Minimum curvature radius	mm	1800	900	400
Maximum casting area	mm	5400 x 3600	5400 x 3400	3600 x 2160
Maximum casting height (actuator travel)	mm	1000	1000	1000
Maximum payload	Kg/m²	225	225	280
Surface Tolerance	+/- mm	2.5	2.0	1.5
Motors and Actuators				
Actuator Density / Distance	mm	300 x 300	200 x 200	120 x 120
Stepper motor Force each	Newton	2000	1000	600
Stepper motor Watts each	Watt	60	32	22
Stepper motor Travel speed	mm/min	300	300	300
Rod system				
Steel rod Ø	mm	10	6	6
CFRP Alignment rod Ø	mm	2.0	1.8	1.8
Magnet Cup Diameter	mm	25	25	15
Magnet Cup Density	Pcs/m²	550	625	1100
Silicone Ferromagnetic Composite Membrane 1 x 1 m				
Magnetic Silicone Composite	Shore	55A	40A	40A
Thickness	mm	18	18	18
Weight	kg/ m²	40	50	50
Surface Roughness	Ra[µm]	1.6	1.6	1.6
Magnetic Surface Pulling Force	Newton	18	30	30
Protective Silicone Sheet 3.6 m				
Thickness	mm	3	3	3
Weight	kg/ m²	15	15	15
Surface roughness	Ra[µm]	1.6	1.6	1.6

Magnetic surface properties, are defined by a pulling force created between a standard NdFeB DIA25x10 N38 magnet and the silicone composite surface

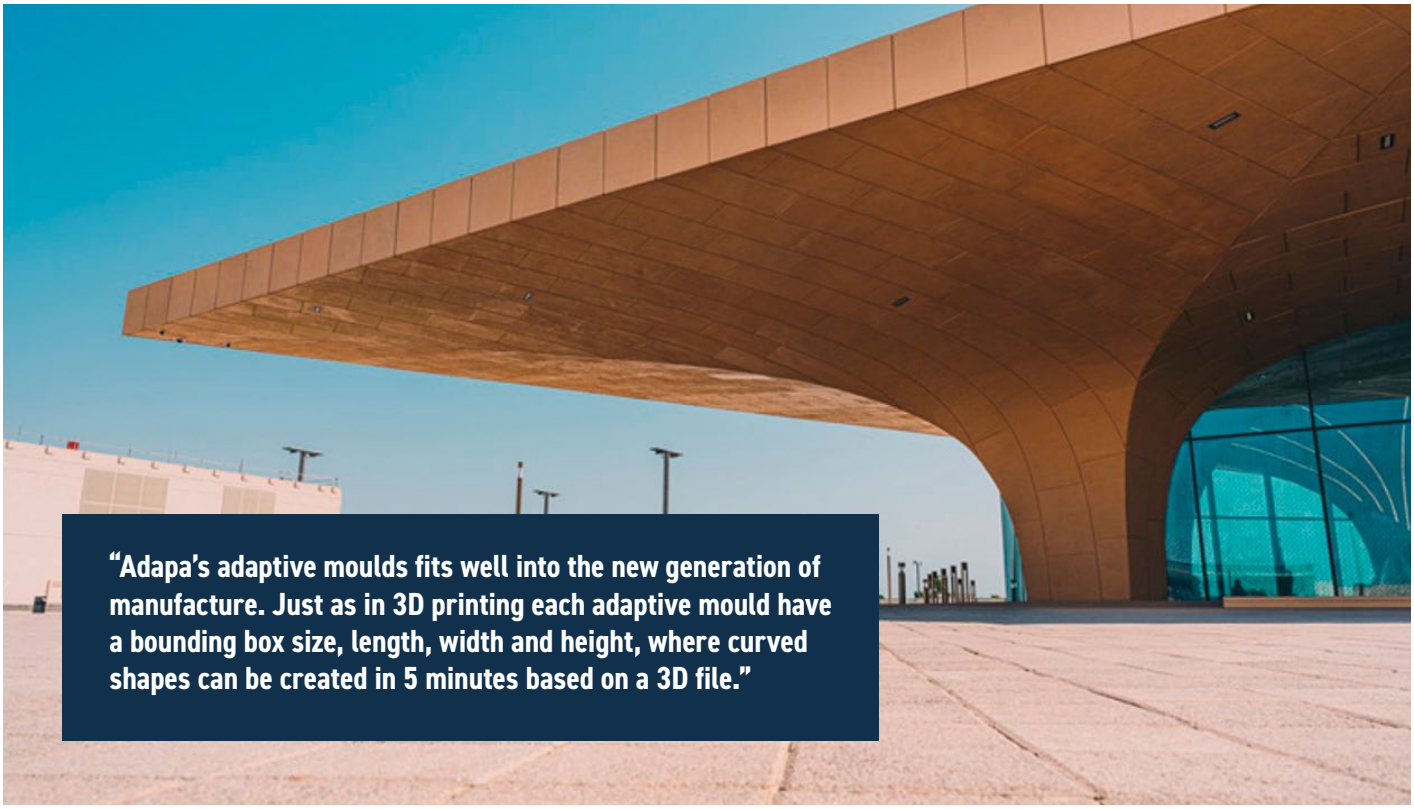


Examples of mould types





There is a rise in demand for curved and organic architecture



"Adapa's adaptive moulds fits well into the new generation of manufacture. Just as in 3D printing each adaptive mould have a bounding box size, length, width and height, where curved shapes can be created in 5 minutes based on a 3D file."

Historic constrained architecture
Earlier, architects were constrained by the inability to produce curved surfaces, which reflected in their low-complexity, symmetric designs. But somewhere in the last two decades, this changed.

It finally seems like we have been liberated from one-dimensional designs. There are various factors that influenced this change, but the primary aspect has been the introduction of technologies that allow the formation of curved shapes.

With the advent of machines that allowed curved panels to be produced, more architects began introducing free form into their designs. But the challenge does not end there. While single-curved surfaces are easy to produce, it is a different ballgame when it comes to double-curved surfaces.

Sustainable moulding tools
Not only do double-curves pose structural challenges, but they are also extremely expensive to make. Curving techniques like CNC milling help produce the desired curvature, but they are neither operationally efficient, nor are they cost-effective.

Compared to the material value, one-off concrete moulds are quite expensive, demands for a lot of workspace and creates waste and emissions that are unacceptable.
The increase in demand for curved architecture demands for re-configurable technologies, that offer both the ability to create free-form architecture and be re-used to lower cost without damaging the environment.
Adapa cooperate with experts from the field of concrete, to assist architects, advisors, and fabricators in creating uniquely curved panels for architecture and design.

The digital toolbox and collaborative technologies
3D drawings, CAD systems and BIM processes are widespread in architecture, planning and construction today. Sharing and cooperating on optimizing the full process support the process for construction of unique and iconic architecture and design.

In the same way, collaborative technologies are knitted together in flexible workflows of reconfigurable technologies pre-set for manufacture of individual designed parts marked with unique id tags. Today we base manufacture on 3D files and go direct to additive manufacture and assembly or on-site construction.

We love curved design

adapa
adaptive moulds

Sustainability

Our commitment is expressed in reusability

Adapa is committed to contributing in whatever way we can, to reduce the impact that greenhouse gas emissions have on our planet.
We urge our industry partners to contribute as well, by looking at non-polluting, environment-friendly methods of production for their future projects.
These principles influence the way we think and act and can be recognized in the fact that, we use materials like aluminum because it is durable and easy for us to reuse, just as we do not paint our machinery because it is easier to recycle materials without paint.

"One-off polystyrene moulds create the same CO2 emission as the cement in an equal sized 20 cm thick precast element that will last for 100 years"

SUSTAINABILITY IS A CORE PRINCIPLE

Adapa is built on the foundation of reusability, and we will continue to strive to incorporate this belief into everything that we do.
Development of our adaptive mould technology is driven by customer demand and market needs.
The way we design solutions, manufacture machinery and service our customers are based on the principles that we:

- innovate to make the manufacture of complex curved surfaces sustainable
- plan to secure transport and production methods with the lowest environmental impact
- choose the materials and parts that are easiest to reuse or recycle
- guarantee the option to return machinery, parts, and materials to our production in Aalborg

CARBON IMPACT REDUCTION IS A CONTRIBUTION

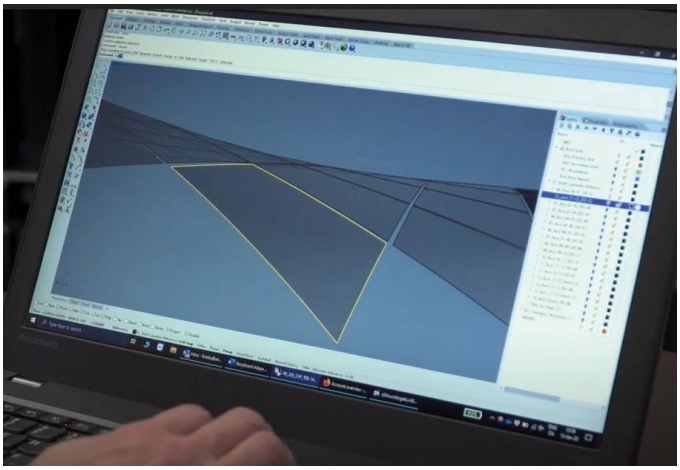
One of the biggest environmental pollutants is polystyrene, as it contains toxic substances such as styrene and benzene.
And yet, it continues to be used as the primary component to make moulds in the manufacturing and construction sectors.

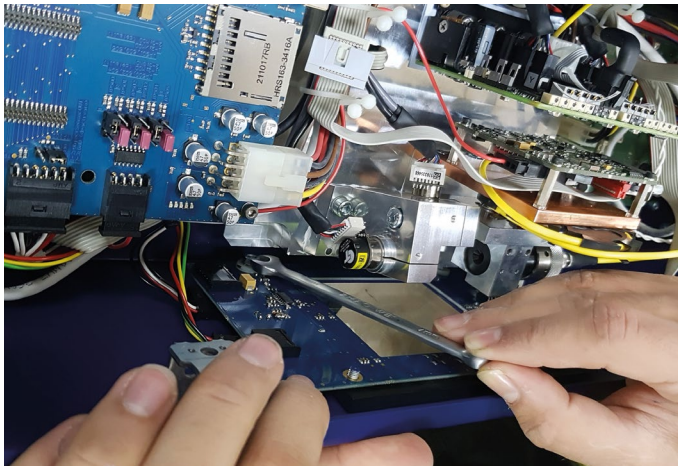
Polystyrene emission facts

- 1 kg polystyrene = 7 kg CO2 emission
- 210 kg CO2 each 1m3 polystyrene
- one-off polystyrene moulds create the same CO2 emission as the cement in an equal sized 20 cm thick precast element that will last for 100 years
- one adaptive mould saves 69 truckloads of polystyrene

Further facts and figures on our website.

Service presentation





Free Mould Optimization
Architects, Designers and Fabricators can benefit from our free Adaptive Mould configuration.

Customized Development
We engage in close technical dialogue to identify the parameters configuring the specific mould solution.

Rental Adaptive Moulds
We offer rental adaptive moulds, to initiate or expand our relationship with customers and partners.

Financing Service
We cooperate with EKF, Denmark's Export Credit Agency, who may secure financing through a bank.

3D CAD Service
We do CAD 3D panel processing and quality assurance for paneling to be produced on the Adaptive Moulds.

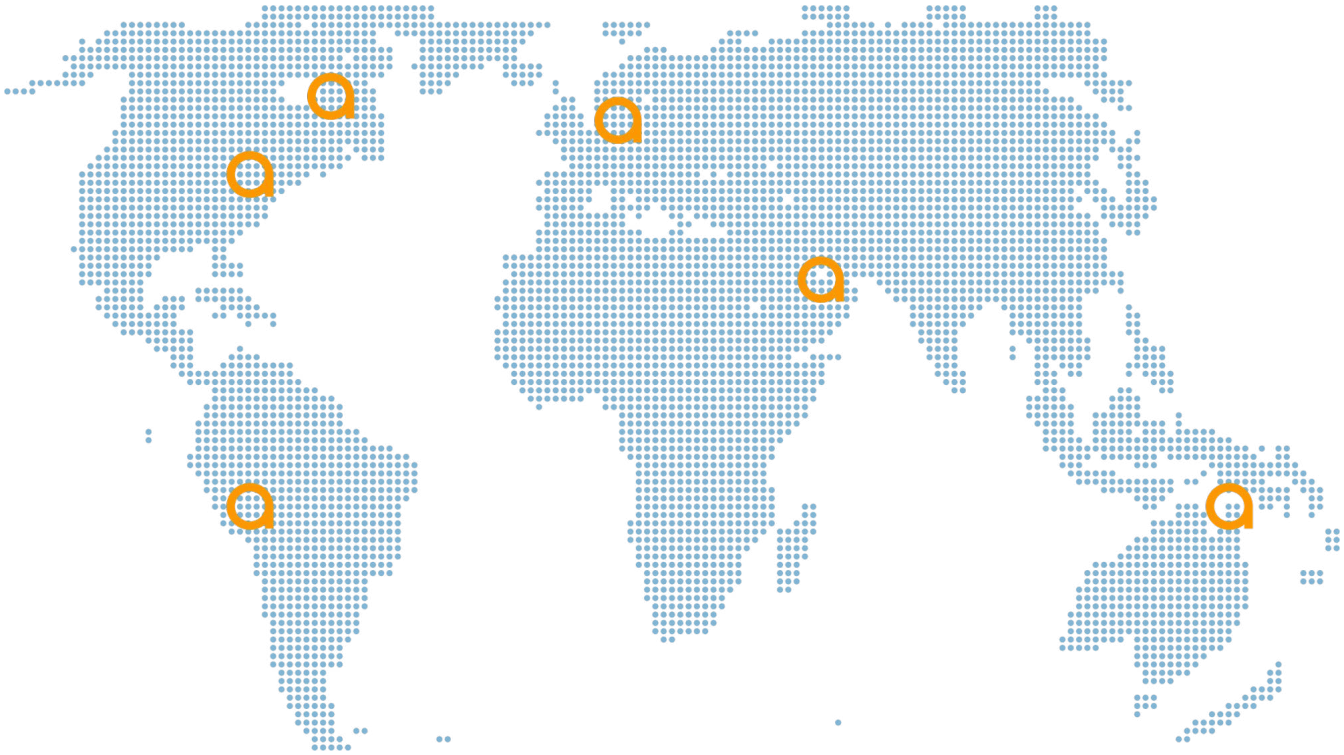
Online Service
We do service and maintenance with Adapa personnel as remote guide and client personell on-site.

On-site Maintenance
We extend warranty when our experienced engineers do service and maintenance on site.

Material and Manufacture
We cooperate with companies that hold specific expertise within materials and manufacture processes.

We are inspired by unique architecture

The inspiration behind Adapa was the curved and organic shaped architecture, that many an architect reach for in the idea and design phase of a project. As the construction starts to be structured in relation to present dominant building systems, to drive down the cost of the architect's unique idea, away goes the curved design. It was exactly this problem and the desire for enabling unique curved designs at the same cost as flat, that engage and commit the people in and around Adapa.



And develop unique robotic 3D mould technology

Adapa A/S hold patents on the most parts of the robotic technology that was the most difficult to develop. It is the technology parts that makes the adaptive mould able to create the controlled double curved surface with low tolerances in only minutes.

We share and create

To achieve the vision of enabling unique design, Adapa need the knowledge from different industries in their range of materials and their work processes. We are also bound to understand the way our partners, customers and influencers think and share knowledge to co-create materials, processes and our technology into workable, easy-to-use and affordable solutions.

With competent commitment

Adapa consists of people that share a large sum of variety. This gives us an advantage in the dialogue with our partners and customers. There is always someone that understand you and "speak the language", whether is concerns business, hardware, software, design, production, logistics, processes, quality etc.

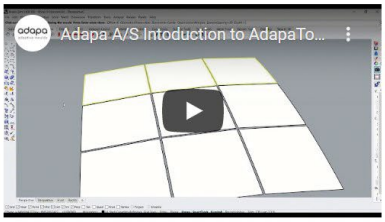
We are online with regional offices

Adapa A/S . Stationsmestervej 83, 9200 Aalborg SV . Denmark . Phone: +45 9340 4142 . Mail: info@adapa.dk

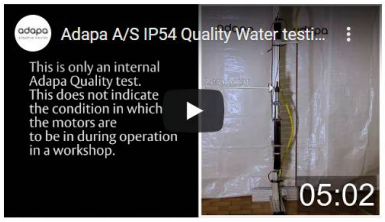
VISIT OUR WEBSITE TO EXPERIENCE APPLICATION SPECIFIC VIDEOS OF OUR ADAPTIVE MOULD TECHNOLOGY

Adaptive Mould Introduction Videos

Adaptive Mould Introduction



Adapa Tools Introduction



IP54 Adapa Quality Test

External Introduction to Adaptive Moulding

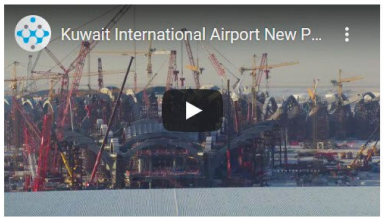
WERNER SOBEK, Managing Director and Partner Lucio Blandini

CURVE WORKS, Tahira Ahmed

METYX Composites, Stephen A. Misencik

Concrete Application Videos

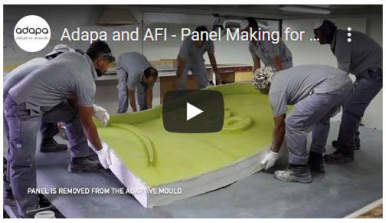
Precast Concrete Wall Panel Manufacture



Kuwait International Airport New Terminal

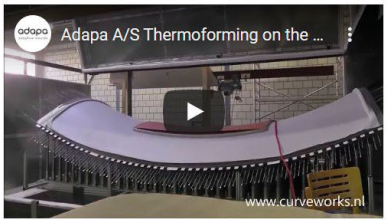
adapa.dk

Composite Application Videos



Fiberglass Panel Making

Vacuum Infusion on the Mould



Thermoforming on the Mould

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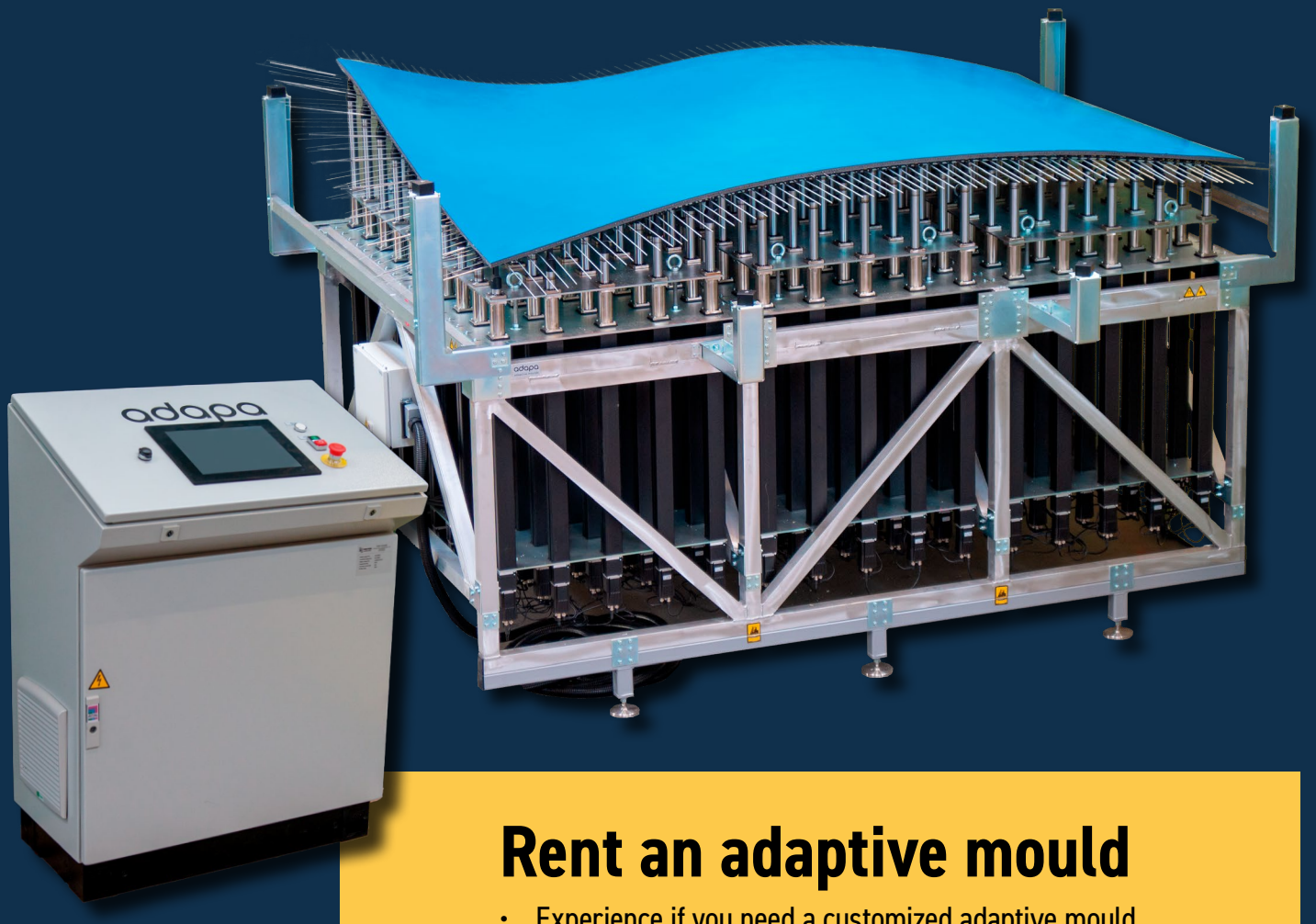
adaptive moulds



Rent an adaptive mould

- Experience if you need a customized adaptive mould
- Do pre-project manufacture of mock-ups or demos
- Manufacture a limited quantity of curved surfaces
- Develop and test your new manufacturing process

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ADAPA A/S

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Denmark

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