



CENTER OF
**APPLIED SPACE
TECHNOLOGY
AND MICROGRAVITY**

WEIGHTLESS
IN THE
**DROP TOWER
BREMEN**



WHAT IS MICROGRAVITY?

Gravity: Every object and every celestial body – such as planets, moons or asteroids – exude their own force of attraction, called gravity. The magnitude of this force is dependent on the mass of the object. The heavier the object, the stronger is the pull of gravity.

Weightlessness: A state in which we cannot feel the effect of gravity is called weightlessness or, to be more precise, "microgravity". This is the case when an object falls to the ground unimpededly. It is in free fall, because there is no other force affecting the falling object.

If we attached scales to our feet before we jump from a diving platform, they would show virtually no weight at all, except for the force the air resistance is exerting to the scales. We can observe the same effect after an object has been accelerated and is now flying upwards, e.g. when we have been thrown into the air by a trampoline. In this case we are in free fall on the way up as well as on the way down.

If we were now able to eliminate the air resistance and perform the free fall in a vacuum, we would achieve a far better quality of microgravity. In the Bremen Drop Tower we are using exactly this effect. Due to the vacuum inside the drop tube we can achieve a quality of one millionth of the Earth's gravity. ◀

HOW DOES THE DROP TOWER WORK?

Scientists from all over the world are using the Drop Tower Bremen, a laboratory unique in Europe, to carry out experiments in conditions of short-term microgravity. The functionality of the Drop Tower is fairly simple. All falling objects are automatically nearly weightless. This applies also to the experiment placed inside the drop capsule, which is an airtight container of 2.5 meter length and 80 centimeter width.

During a simple drop experiment, the capsule is pulled to a height of 120 meters to the top of the drop tube and then released. After 4.74 seconds the experiment lands safely in the deceleration chamber filled up to 8 meters with polystyrene spheres.

Before the experiment, 18 high-performance pumps make sure that the drop tube is almost free of air, containing only one ten

thousandth of the normal air pressure. Due to the vacuum, the air resistance is so low that the quality of microgravity is better than in any other test facility worldwide – in some aspects even better than on the International Space Station.

Therefore, the Drop Tower Bremen is an economic and easily accessible alternative to doing research in space. ◀



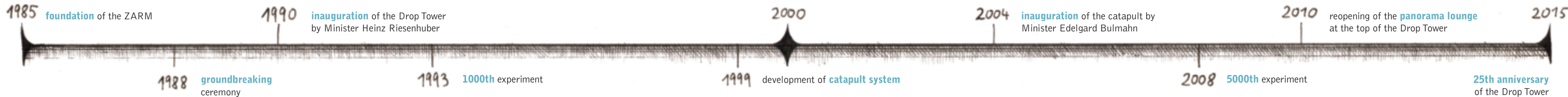
WHAT IS EXCEPTIONAL ABOUT THE CATAPULT?

When breaking ground for the Bremen Drop Tower on May 3, 1988, the installation of a catapult system underneath the building had already been taken into account. 16 years later, ZARM engineers finished designing the catapult system. It was installed 10 meters below the surface and inaugurated on December 2004. The pneumatically driven system takes 0.25 seconds to accelerate the experiment capsule to a speed

of 168 kilometers per hour. The exact force is calculated for each individual experiment in order to lift the drop capsule as close as possible to the top of the drop tube and thus maximize the duration of the flight. By doubling the trajectory length it is possible to extend the period spent in microgravity to 9.3 seconds – an experiment duration no other drop facility can provide. ◀

WHO CAN USE THE DROP TOWER?

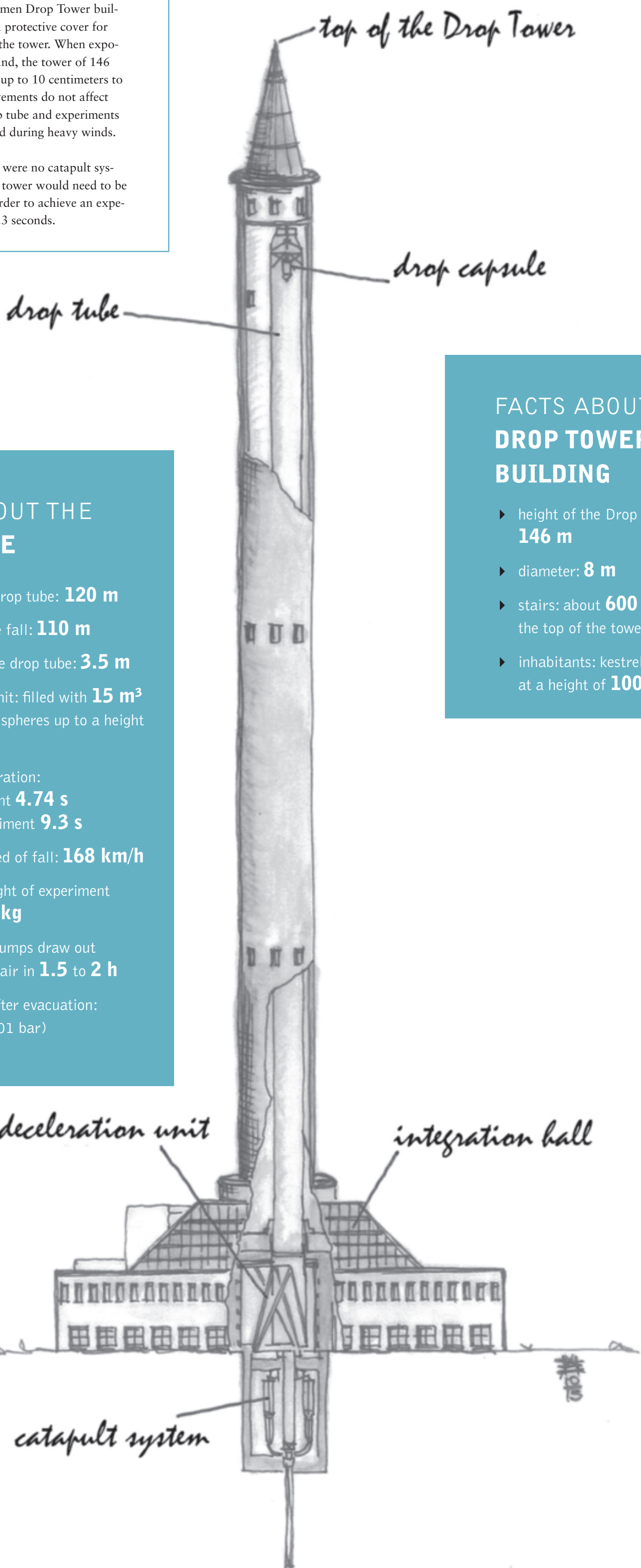
Research teams from all parts of the world and from different scientific disciplines – such as fluid dynamics, materials sciences, combustion, biology and biotechnology as well as from fundamental physics and astrophysics – have benefitted from the excellent conditions in the Bremen Drop Tower for more than 25 years. Up to 400 drops are carried out per year. ◀



DID YOU KNOW?

The eye-catching Bremen Drop Tower building is actually just a protective cover for the drop tube inside the tower. When exposed to the force of wind, the tower of 146 meters height moves up to 10 centimeters to each side. These movements do not affect the freestanding drop tube and experiments can also be conducted during heavy winds.

Noteworthy: If there were no catapult system in the tower, the tower would need to be 424 meters high in order to achieve an experiment duration of 9.3 seconds.



FACTS ABOUT THE DROP TUBE

- ▶ height of the drop tube: **120 m**
- ▶ distance of the fall: **110 m**
- ▶ diameter of the drop tube: **3.5 m**
- ▶ deceleration unit: filled with **15 m³** of polystyrene spheres up to a height of **8.20 m**
- ▶ experiment duration:
drop experiment **4.74 s**
catapult experiment **9.3 s**
- ▶ maximum speed of fall: **168 km/h**
- ▶ maximum weight of experiment capsule: **500 kg**
- ▶ vacuum: **18** pumps draw out **1700 m³** of air in **1.5 to 2 h**
- ▶ air pressure after evacuation: **10 Pa** (0.0001 bar)

FACTS ABOUT THE DROP TOWER BUILDING

- ▶ height of the Drop Tower Bremen: **146 m**
- ▶ diameter: **8 m**
- ▶ stairs: about **600** steps until the top of the tower
- ▶ inhabitants: kestrel birdhouse at a height of **100 m**

CAN I VISIT THE DROP TOWER?

For the public, there are several options to visit the Drop Tower or to book the location at the top of the Drop Tower for a private event. A Drop Tower visit includes an introduction into the world of micro-gravity, the functionality of the drop and catapult system as well as an insight into the laboratory. The meeting room and the panorama lounge on the top of the tower can be booked for business meetings as well as for family events. At a height of about 140 meters our guests can enjoy a fascinating view of the nature reserve "Blockland", the technology park and, of course, the Hanseatic City of Bremen. Since 2014, it is even possible to get married in the highest official wedding location in Bremen. During the champagne reception, which is offered after the wedding ceremony, the newly-weds and the guests can enjoy a wonderful 360 degree view of Bremen. ◀

CONTACT

ZARM visits

0421 – 218 57900 | visit@zarm.uni-bremen.de

booking of panorama lounge and wedding ceremonies

0421 – 218 57754 | office@zarm.uni-bremen.de

AM FALLTURM 2 | 28359 BREMEN

▶▶ WWW.ZARM.UNI-BREMEN.DE