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Development of a New Aerial Apparatus: "Asymmetrical Straps"

DESIGN REPORT

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With the support of the National Circus School team :

Ilya Baranov – aerial straps teacher
Howard Richard – artistic advisor
Pascal Tétrault – rigger
Jean-Philippe Dalcourt – rigger
Anna-Karina Barlati – librarian

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INTRODUCTION

This report presents the design stages of a new apparatus: the Asymmetrical Straps. We will see the different design stages and the development of a new acrobatic vocabulary. Next, the challenges encountered and the recommendations will be discussed.

The development of the Asymmetrical Straps was done in collaboration with the riggers of the National Circus School (NCS), in particular Pascal Tétrault and Jean-Philippe Dalcourt. The project was imagined by Marceau Bidal, and accompanied by Howard Richard and Ilya Baranov.

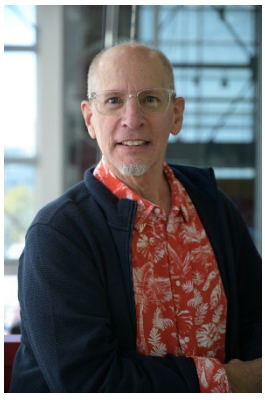
This is not a usage or manufacturing guide, but an overview of this new apparatus. The concept of the Asymmetrical Straps belongs entirely to its inventor, Marceau Bidal, who holds the rights of paternity.

Please note that the apparatus plans are confidential, and for any questions, it is important to contact Marceau Bidal (marceauproduction@gmail.com). To see the result of the apparatus, you can watch the trailer for the show "Crash Éphémère" presented at the 2023 Synthesis Exams of NCS: https://youtu.be/dD2vkOyDZ24

Apparatus Design Team :

Marceau Bidal	**Ilya Baranov**	**Howard Richard**	**Pascal Tétrault**	**Jean-Philippe Dalcourt**
Circus Artist, National Circus School Graduate	Aerial Straps Teacher at the National Circus School	Artistic Advisor at the National Circus School	Rigger at the National Circus School	Rigger at the National Circus School





I. Presentation of the Asymmetrical Straps

1. A derivative of aerial straps

The new apparatus presented in this report is a derivation of the aerial straps used in the aerial straps discipline.

Aerial straps is a circus discipline that has been practiced for centuries around the world. It combines flexibility, strength, and acrobatic technique. The origins of this discipline are difficult to trace, but it's clear that it is constantly evolving. Pascal Jacob and Magali Sizorn have written articles published by the National Circus Arts Center (CNAC) at the National Library of France (BNF) tracing the history of the discipline [1]. In this report, we rely on the manual of the European Federation of Circus Schools (FEDEC) as a reference framework for the aerial straps discipline [2].

2. The development of aerial straps

This new apparatus is a concept that uses two straps installed on a pulley system, which allows for additional acrobatic figure opportunities in the aerial straps discipline.

Asymmetric straps are practiced both on the ground and in the air. It's an apparatus that requires a high attachment point and a puller (a person allowing the apparatus and the acrobat to change height). The straps used, resembling two straps, are several meters long and end with a loop. Working on these straps allows movement supported by the arms and legs, figures in suspension, roll ups, falls or with ground contact. Like the aerial straps discipline, this apparatus offers the possibility of performing large rotations or movements over the arena or audience: these are movements in which the acrobat swings on a large amplitude, forming either a rotation or a back-and-forth movement. However, asymmetric straps are distinguished by the swing play that changes the acrobat's balance when using the apparatus. Thus, a vast and new acrobatic vocabulary is developed through this apparatus.

3. Choice of name

The name "Asymmetric Straps" was chosen to designate the new apparatus and the resulting acrobatic research. The name refers to the aerial straps discipline, and the use of the term "asymmetric" refers by definition to its unbalanced and non-fixed aspect (unlike the aerial straps that remain symmetrical to each other).

This name was developed in relation to the riggers of NCS, following historical research carried out in its library.

II. Design Steps

1. Apparatus design

The idea for the design of this apparatus came from Marceau Bidal in October 2021 during training at the National Circus School of Montreal. "I was looking for new ground positions with classic aerial straps, and the idea came to me while looking in the mirror to pull one of the straps to make the other rise."

The first idea with which Marceau explained his concept to the riggers of the school was to install a single strap on a carabiner to create new ground movements with this pendulum system. Very quickly, Pascal Tétrault and Jean-Philippe Dalcourt adjusted the different components to meet Marceau's requests. A first prototype appeared. The idea was to connect two straps with a rope placed in a pulley system.

Aerial acrobatic figure,directed by Marceau Bidal at the NCS (January 2023)

This apparatus has since evolved several times, the different elements that make it up have been adjusted to allow the artist to develop a wide acrobatic vocabulary. Different types and lengths of rope, pulleys, straps, swivels, and loops have been tried.

Finally, a locking system was added to stop the rope on each side when its end, connected to the swivel, is close to reaching the pulley. These two blockers absorb shocks by protecting the knots and swivels at both ends of the rope.

The apparatus was finalized in April 2022, to allow Marceau to perform his act and integrate it into a show. However, a second research phase is already planned to develop other versions.

2. The research for acrobatic vocabulary

Extensive acrobatic research was conducted on this apparatus by Marceau Bidal (inventor) and accompanied by Ilya Baranov (aerial straps teacher) and Howard Richard (artistic advisor).

Some aerial straps figures could be reused, but their execution technique is different, and the handholds are very specific (see page 8). The discovered acrobatic vocabulary can be categorized into several categories.

A- Aerial movements (when the artist is a few metres off the ground):

- Using two different body parts, which can be two hands, or an upper and lower limb, all using the pendulum system that the apparatus offers.
- In fixed rotation, large turns, and swinging.
- Where the two loops of the straps are connected together, creating a large loop in which the artist can perform.

Aerial acrobatic figure, directed by Marceau Bidal at the NCS (October 2021)

B- Movements with contact with the ground:

- Where the acrobat performs close to and on the ground, using the pendulum of the asymmetrical straps to transform their own balance.

Aerial acrobatic figure, directed by Marceau Bidal at the NCS (August 2022)

C- Figures with falls :

- Several movements have been created with the release of one of the straps. In this situation, the artist falls from the length of the rope that connects the two straps and ends up in a position with only one strap. (We will discuss this type of figure in the 'Challenges Encountered and Recommendations' section (page 8)).

D- Figures in duo and collective:

- Derived from aerial figures in duo straps, using one or both straps at the same time.
- Acrobatic research in collective (with ground lifts and hand-to-hand), playing with the pendulum system to evolve at different heights.

Tryptique, from NCS, "Les préposées," directed by Anna Ward, (2022)

3. Workload calculation

During the creation process of the apparatus, in the fall of 2021, the riggers from NCS and Marceau decided to measure the workload of this new apparatus to ensure the safety of the exercises.

After a year of experimentation, a new load measurement was made with a dynamometer. It was placed between the device and the 3/1 attachment system (pulley). Marceau performed different movements with one or two arms, including rotations, swings, and falls. The maximum load that the acrobat generated on the apparatus while performing these figures was 268 kg (or 590 pounds). At that time, Marceau weighed 68 kg (150 pounds), which represents 3.9 times the weight of the acrobat. This value is much lower than what was measured on aerial straps in a previous study, where the maximum force was 7.9 times the weight of the acrobat [3].

It is possible that the entire apparatus absorbs some shocks, through the rope, knots, and rubber blockers.

Examples of data collected when using the asymmetrical straps on November 11, 2022 :

Acrobatic figures that generate a significant workload	**Description**	**Dynamometer placed between the apparatus and the attachment ?**
Acrobatic figure specific to the asymmetrical straps		
« Side Drop »	Release of one strap and ending in a tuck position in the second strap	268 kg
« Suicide Drop »	Release of one strap during transfer and ending by hanging with one arm	242 kg
Acrobatic figure inspired by aerial straps		
« Two-arm swing »	Regular two-arm swing	248 kg
« One-arm swing »	Swinging with one arm while performing a figure	218 kg

Data recorded by the riggers of the National Circus School of Montreal. These data are specific to the equipment used, the acrobat, and the acrobatic technique performed.

A final test was conducted in 2023 to test the maximum workload that the equipment can support. These data are kept confidential by Marceau Bidal and Jean-Philippe Dalcourt.

III. Challenges Encountered and Recommendations

1. The dangers of an unknown discipline

The use of asymmetrical straps offers a wide range of possibilities. However, it is important to consider that performing aerial strap movements using both straps requires a new technique since weight transfers are completely different. It is possible that certain movements mastered in other disciplines can be dangerous when attempted with asymmetrical straps. Therefore, if someone were to try this equipment, they should not attempt two-arm aerial strap movements without being aware of these weight transfers.

The development of a new technique and vocabulary specific to asymmetrical straps was necessary for this equipment.

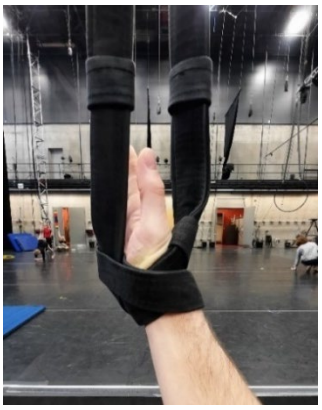
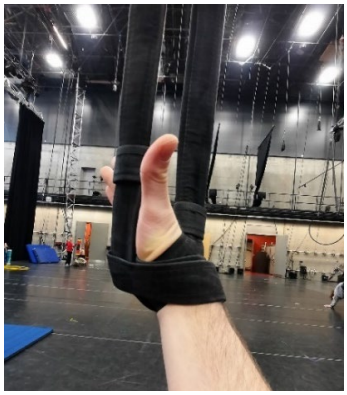
2. The importance of handgrips in loops

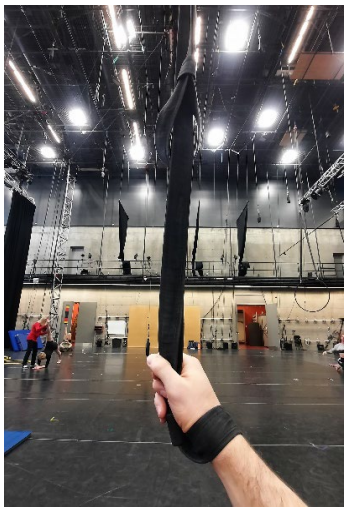
A. One arm

Asymmetrical straps can be used for one-arm acrobatic figures by holding both straps with one hand. This category of one-arm suspension movements can help to regain aerial strap technique. However, some minor accidents have occurred because the way of holding the two straps in the hand must be done precisely (differently from aerial straps) :

- -First, it is preferable that both straps be held by a choking loop.
- Then, the order in which the straps are inserted is very important:
    - Insert the hand into the loop of the first strap.
    - Insert the wrist into the second strap and close the slider as much as possible.
    - Grab the first inserted strap in your hand and make sure it blocks the second strap sufficiently.

➔ An improper one-arm use can cause one of the straps to slip through the loop of the second strap, thus causing the user to fall the length of the rope that connects the two straps.

An example of the safest handgrip with a choking loop	
	*This situation is the most safe, the two straps are crossed and taken in a choking grip in the hand.*
An example of a good hand grip.	
	*In this situation, the straps are crossed, the first inserted strap is in a choking grip, and the second is closed using a slider.*

An example of a bad hand grip, the acrobat risks falling.		
		
1. Bad hand grip at the start	*2. During the execution of an acrobatic figure*	*3. Acrobat falls*

B. Two arms

In a two-arm grip, handholds can be made with the slider or in a choking grip.

The choking grip is the safest grip studied in a comparative study of nine strap attachment configurations conducted by Marion Cossin [4].

3. Adding a blocker

A rubber circle has been added to the apparatus to prevent the rope knot and swivel from meeting the pulley. This addition stops the rope from slipping in the pulley at its ends. Thus, this locking allows the development of certain falling figures. The acrobat can release a strap and that way fall the length of the remaining rope to ultimately be stopped by the blocker.

It should be noted that this type of figure must be carefully monitored by a professional, as it can be dangerous for the acrobat and generate an important workload on the apparatus.

IV. Conclusion and Acknowledgements

This report presented the design of a new piece of equipment: the asymmetrical straps. It has not yet demonstrated its full potential and much research is still being done to develop it, whether alone, in pairs, or in groups.

It is important to note that the development of new equipment should always be approached with caution, curiosity, and safety.

Thanks to :

Pascal Tétrault, Jean-Philippe Dalcourt, Bilbo Rochette, Andrew Michael Mitchell: riggers from the National Circus School.

Ilya Baranov: aerial straps, trampoline, Russian cradle, and hand-to-hand teacher at the National Circus School.

Howard Richard: artistic advisor, formerly director of creation at the National Circus School of Montreal.

Anna-Karyna Barlati: librarian at the National Circus School.

Photo credit: all photographs in the report were taken by Frédéric Langevin or Marceau Bidal.

Marceau Bidal, circus artist, graduate of NCS 2023 see at : https://marceauproduction.wixsite.com/marceau/asymmetricsstraps

V. Bibliography

[1] Jacob P. and Sizorn M., Bibliothèque nationale de France (BNF), Centre national des arts de cirque (CNAC) de Châlons-en-Champagne. The Aerial Straps. [Online]. Available: https://cirque-cnac.bnf.fr/fr/acrobatie/aeriens/les-sangles

[2] European Federation of Circus Schools (FEDEC). (2007). Basic Instruction Manual for Circus Arts. Brussels. [Online]. Available: http://www.fedec.eu/file/251/download

[3] Cossin, M. (2019). Comparative study of nine aerial strap attachment configurations. Technical report, Montreal. [Online]. Available: https://ecolenationaledecirque.ca/wp-content/uploads/2022/08/rapport_etude_comparative_de_neuf_configurations_dattache_en_sangles_aeriennes-1.pdf

[4] Cossin, M., Ross, A., & Gosselin, F. P. (2017). Making single-point aerial circus disciplines safer. Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology, 231(4), 362-373.

Ilya Baranov, Marceau Bidal, and Howard Richard are the creative team behind the "Crash Éphémère" aerial straps act, which was presented at the National Circus School's 2023 final exams. You can watch a trailer of the act at the following link: https://youtu.be/dD2vkOyDZ24