

Title of the course: Exoskeletons in the construction trades	
<b>The target group for the teaching course:</b> Basic training - Construction trades – Carpenter, Bricklayer and Structural Engineer	
<b>Keywords/Search words:</b> work environment; exoskeletons; exoskeleton; health; lifting technique; ergonomics; carpenter; mason; structures. heavy lifts; work tools; lift; erosion; stress disorders; sustainability development goals	
<b>Theme:</b> Working environment - Exoskeletons as a tool for the prevention of early wear and tear and work-related stress disorders	<b>Recommended duration of lessons:</b> 4-5 lessons
<b>Description for the teacher:</b> The teaching course contributes to the practice-oriented teaching in the working environment and gives the students/apprentices a tangible approach to the aid Exoskeleton in their subject group. The course contains some general knowledge about the subject, after which Exoskeleton is tested in relevant work processes. Thereby the optimal use of Exoskeleton is found and at the same time it clarifies where it is not necessarily applicable.	
(Danish) Formal goals: BEK no. 234 of 06/03/2023 - Decree on construction training for wood trades BEK no 627 of 12/05/2022 - Executive order on vocational training for bricklayers BEK no. 632 of 16/05/2022 - Executive order on the vocational training for civil engineers, building engineers and pavers.  Common to the 3 fields of study are competencies prior to admission to school education in the main course §3 subsection 2 p.11 (take care of own and others' safety in known work situations, demonstrate use of the body, in different working positions, movements and workflows and selection thereof with a view to prevent strain and identify dangers and accidents before solving tasks)  Learning Objectives: 1. You will be able to identify various general working postures and processes that can be advantageously carried out with Exoskeleton as an ergonomic tool. 2. You can apply and remove Exoskeleton, as well as guide others in its use. 3. You can use Exoskeleton in practice, by demonstrating lifting, twisting and similar movements in known work processes. 4. You can explain how Exoskeletons can remedy wear and tear, muscle/skeleton problems and the like.	
<b>Contents:</b> The student, or apprentice, is introduced to Exoskeleton as an ergonomic tool in the construction industry. This covers discussions about the working environment, lifting techniques, workloads, and general ergonomics. Work processes and planning will be topics that make the application more practice oriented. Group work with practical exercises is recommended to achieve learning objectives on the use and demonstration of the Exo-skeleton equipment.	

**Methods and teaching principles in the course:**

In this course, the following principles and methods are used in connection with the learning activity:

- Presentation by the teacher
- Video in plenary or in independent group work
- Demonstrations and exercises in use
- Presentations/Demonstration of use
- Dialogic teaching (understanding and exchange of experiences)

The activities in the course

Video demonstrations from the Exoskeletons' supplier, data and facts from the Norwegian Working Environment Authority (AT.dk) are used. In the workshop, we work with various practical situations that the student/apprentice encounters in their subject.

The course includes:

- Basic knowledge of ergonomics and working environment
- Practical work in the workshop, with and without Exo skeletons
- Collection, reflection, and dialogue about the use of ergonomic aids.

**Teacher role:**

The subject teacher prepares in the presentation on the basic knowledge and ergonomics and working environment, as well as familiarizes himself with the structure and function of the Exoskeleton.

When holding the course, the presentation is presented, and the video series is shown.

Workshop exercises are prepared for practical work with the Exoskeletons. Here, the subject teacher must guide in application and make room for opinions and attitudes.

**Participant role:**

The student's or apprentice's experiences, attitudes and opinions about the working environment, work situations and processes are brought into play. As it can vary how much experience students and apprentices have from practice, it is an advantage that they are placed in groups for dialogue and sparring.

The student or apprentice uses the equipment correctly and is receptive to knowledge about general ergonomics and the working environment in the construction industry.

**Organization:**

After the plenary presentation, the class is organized into groups of approx. 3-4 people. It is an advantage to use the same group composition in both the theoretical and practical part of the course.

**Teaching room:**

Classroom for plenary presentations and collection of the topics.

Workshop for carrying out practical exercises with lifting, twisting and similar movements in known work processes.

In the workshop, workstations must be set up with various relevant work processes in the subject. Type and quantity may vary, for example it may be:

- Lifting of sacks from one location to another
- Twist movement in connection with continuous work tasks
- Work at floor level (of different nature)
- Mounting items above head height

Several/relevant examples should be discussed in the teaching team, prior to the lesson.

## Differentiation:




The course is differentiated by putting together the groups with a mixture of experienced and inexperienced students or apprentices. Likewise, the groups are formed with a sensible alternation between introverted and extroverted students or apprentices, as practical exercises must be carried out which can hold back certain student types.

When presenting and presenting in use and explaining the use of Exoskeletons, the teacher can differentiate by acting as a guide/questioner during the performance.

## Schedule:

The course starts with a plenary presentation, where the topics below are touched on in the course's PowerPoint. After this, it is further explained how the practical work is advantageously carried out in the workshops. The teacher can create a survey on <https://www.mentimeter.com/> Where the apprentices can type in their knowledge and thoughts on the subject. Use the answers as a way to introduce the subject.

1. A short introduction to why it is relevant to work with working environment, ergonomics, and exoskeletons in relation to the SDG`s (15min.)

 <p><b>8</b> ANSTÆNDIGE JOBS OG ØKONOMISK VÆKST</p>	<p>8.5 (Create full employment and decent work with equal pay)</p> <p>8.8 (Protect employee rights and create safe working environments)</p>
 <p><b>9</b> INDUSTRI, INNOVATION OG INFRASTRUKTUR</p>	<p>9.2 (Support inclusive and sustainable industrialization)</p> <p>9.4 (Upgrade all industries and infrastructure for sustainability)</p>
 <p><b>12</b> ANSVARLIGT FORBRUG OG PRODUKTION</p>	<p>12.6 (Motivate companies to act sustainably)</p> <p>12.8 (Give all people the knowledge and understanding to be able to live sustainably)</p>

2. The apprentices are divided into groups, here the link is used - Working environment in numbers Let the pupils work with the link and find figures on injuries that may be relevant in relation to their subject. (30 min.). The students reflect and share their knowledge in groups, after which knowledge can be advantageously shared in a plenary debate.
3. The teacher reviews the theoretical part of the Exoskeletons.
  1. As an example the Hapo harness: Dedicated to assisting workers in a standing position whose postural or articular constraints contribute to the difficulty of their work.
  2. It relieves the back and helps maintain a good posture, whether in full flexion or standing.
  3. By partially redirecting the efforts of the upper trunk - pectoral support - towards the thighs with the help of the springs and by maintaining - without restraint - the lumbar vertebrae with the help of its belt, the HAPO participates significantly in the reduction of musculoskeletal disorders (MSD). The belt allows for the maintenance of the lumbar region without restraint. If the principle in static standing or dynamic bending position remains the same, the latter offers a increased comfort and an comfort and improved user experience.
4. Presentation on musculoskeletal disorders by the subject teacher (30 min.)

5. Video demonstrations from respectively The Knowledge Center for Sustainability and Craftsmanship, as well as the manufacturer.

[Video 3](#) (6 min.) (The producer's own introductory film)

[Video 4](#) (7 min.) (The producer's own introductory film)

[Video 5](#) (2 min.) (The producer's own introductory film)

[Video 6](#) (8 min.) (The producer's own introductory film)

[Video 7](#) (2 min.) (The producer's own introductory film)

(Collected time 45 minutes.)

6. The apprentices must work with the Exoskeletons in the workshop and test practical work situations. The subject teacher demonstrates the work at the stations without Exo skeletons. These are drawn up by the subject teacher prior to the lesson. The groups must go from station to station. 30 minutes each station, including rotation. 5 stations must be set up. (2.5 hours)
7. The mentioned exoskeletons below are suggestions, and will differentiate from school to school.

Station 1: Exo-skeleton Liftsuit from Auxivo

Station 2: Exo-skeleton Hapo PH

Station 3: LegX

Station 4: BackX

Station 5: ShoulderX

Make sure the students have photos taken for any portfolios.

7. Link to final Kahoot (30 min.)

**Evaluation criteria (goals and process):** The participants are measured on their activity and participation in being able to identify different working positions and processes, which can be advantageously carried out with Exoskeleton as an ergonomic tool.

During the workshop exercises, students and apprentices are assessed at the stations to see if they achieve the learning objective of being able to put on and take off Exoskeleton, as well as guide others in the group in its use.

During the same exercises at the stations, the student or apprentice will demonstrate the use of Exoskeleton in known work situations and processes.

To ensure learning and understanding of the subject, the student's or apprentice's knowledge will be tested in a Kahoot, which reveals whether he/she can explain how Exoskeletons can alleviate wear and tear, muscle/skeletal difficulties, and the like.

### **Ongoing feedback:**

Ongoing feedback is recommended, in the form of guiding dialogue and a questioning approach from the teacher. Before the group work and the workshop stations, a thorough feedforward is carried out, so that everyone is aware of the process and does not feel in "deep water".

In the group work, if possible, you can be encouraged to include experiences from the training site, which can contribute to feedback among the group's other participants. This will support the participant's learning processes and can strengthen both the giver and receiver of the feedback.

<b>Summative/final evaluation:</b>	
Let the students create a Mentimeter where they describe their experiences of the subject (anonymously). <a href="https://www.mentimeter.com/">https://www.mentimeter.com/</a>	
Educational materials developed for this learning activity: Instructional video from knowledge center and manufacturers. Theoretical material describing the Exo skeletons. PowerPoints with presentations and teacher guides in the notes area.	
<b>Date:</b> 13-08-2023	<b>Written by:</b> Jimmy Uldbjerg og Lars Jensen

**Message to the performing teacher:**

**Remember your own reflective evaluation of the course, during and after the course.**