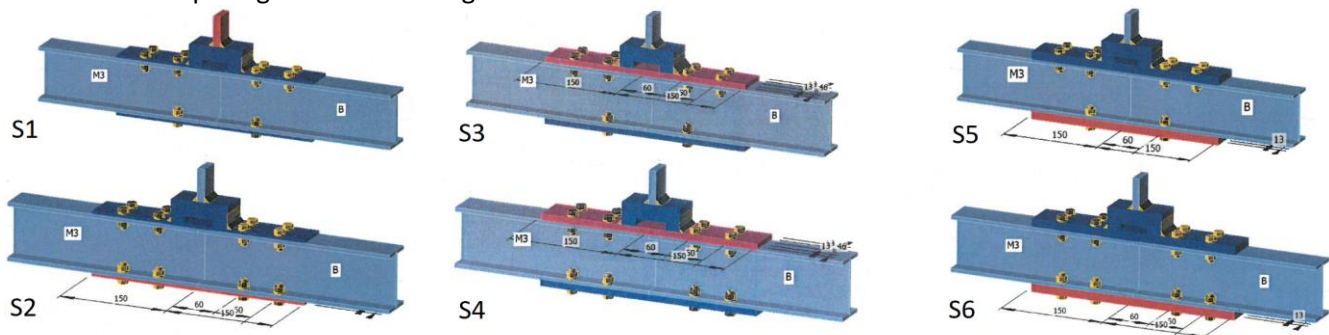


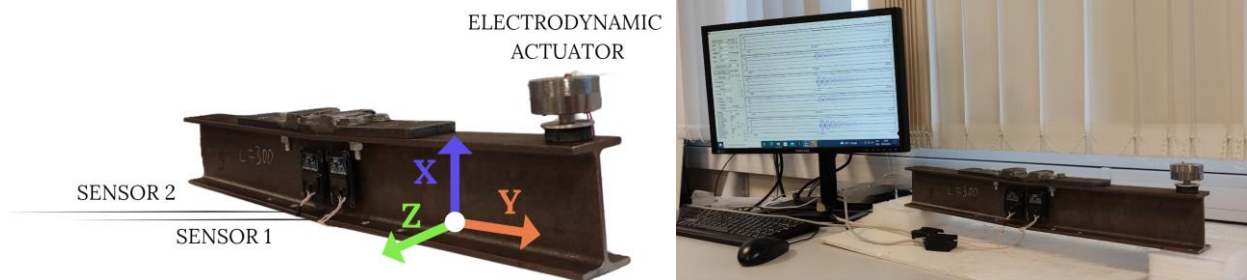
## Description of the experiment: Damage detection of steel splice-type connection by Coaxial Correlation Method in 6-D space

The steel beam specimens with splice connection were considered as the object of study (Figure 1). The investigated steel specimens consisted of S355 strength class parallel flange I section IPE 80 steel beam elements with dimensions according EN 10365, where the height is 80 mm, the width is 46 mm, the web thickness is 3.8 mm, the flange thickness is 5.2 mm, and the root fillet radius is 5.0 mm. A total length of the specimen is 600 mm that had been halved and joined using two metal plates with dimensions of 46 mm × 300 mm and three different thicknesses – 4 mm (S1, S2), 8 mm (S3, S4) and 12 mm (S5, S6). One metal connector plate is positioned on the top face and the other on the bottom face of the specimen. The connection between the steel beam and steel plates was established using 8.8-grade M8 bolts in amount of 12 (S1, S3, and S5) or 16 bolts (S2, S4, and S6). The positioning of holes for bolts is adopted following the requirements of the Eurocode EN 1993-1-8 of minimum and maximum spacing and end and edge distances for bolts.



**Figure 1.** Steel beam specimens with splice connection with maximum value of the bending moment that the specimen can absorb: S1 – 2.250 kNm, S2 – 3.625 kNm, S3 – 2.625 kNm, S4 – 4.750 kNm, S5 – 3.125 kNm, and S6 – 5.500 kNm.

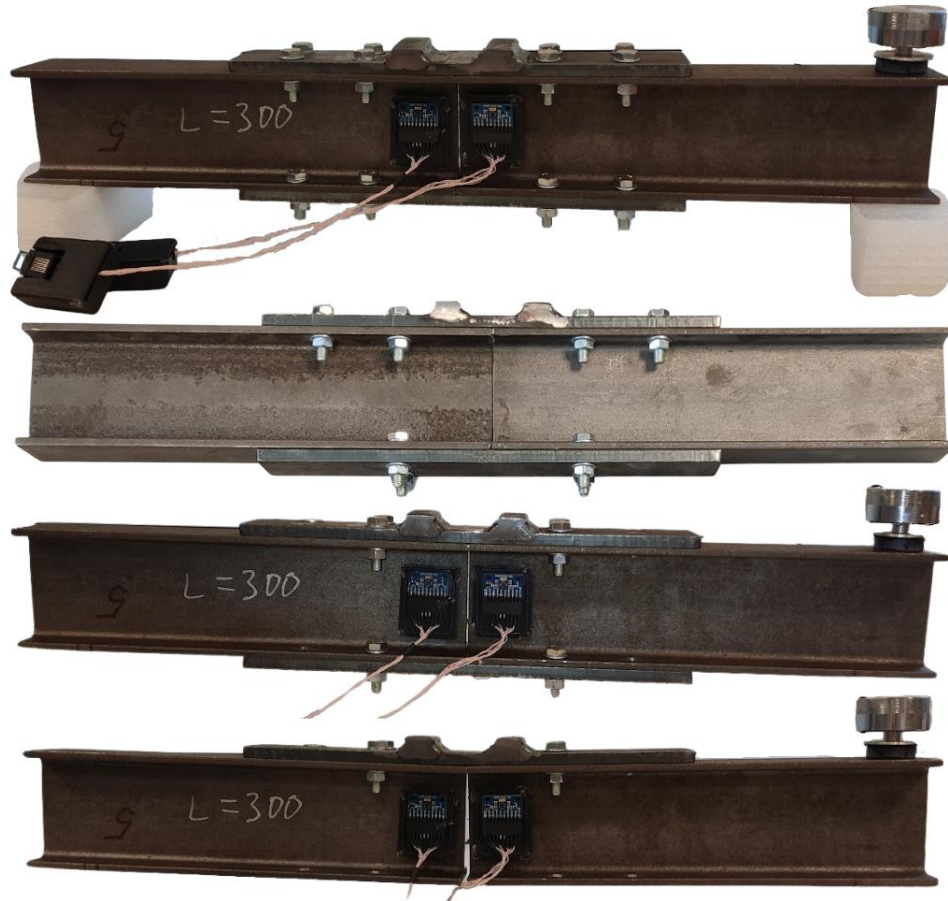
The vibration load on the specimen was generated by electrodynamic actuator placed at the right end of the beam as it can be seen on the Figure 2. Two 6D sensors were coaxially placed on the beams on either side of the investigated joint. 6D sensors are implemented by MPU-9250, which contains a 3-axis gyroscope and a 3-axis accelerometer. The specimen axes in accordance with the sensor's axes are shown on Figure 2, where vertical axis is X, the longitudinal axis of the specimen is Y, and the transversal axis of the specimen is Z. During the experiment, constant support conditions for the specimens are provided: simply supported (roller-roller) on vibration-absorbing supports with a span of 500 mm.



**Figure 2.** Placement of sensors and electrodynamic actuator, the axis of the specimen and the process of the data collection.

The data set consists of two parts. The first part of the data set is measurements for each of the six specimens with wave type impact – sweep signal with duration 0.05 s. The second part is the measurements during splice connection degradation of the S4 specimen (Figure 3) with short impulse. The degradation of a connection during operation has been artificially characterized by unbolting the bolts and removing the metal connector plate. The order of unbolting was as follows: first, the 4 bottom bolts were unbolting, 2 edge bolts on each side of the joint;

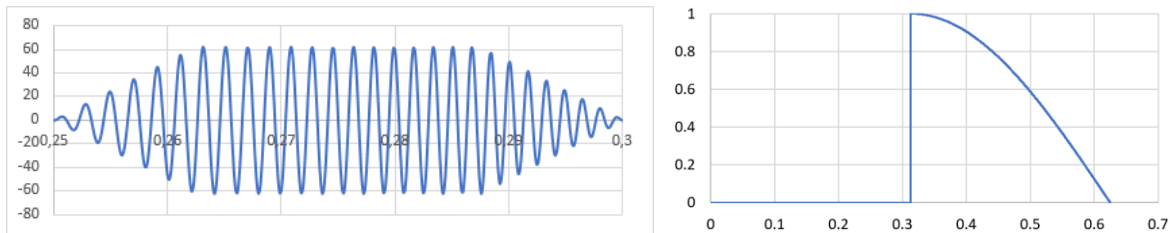
second, the 4 top bolts were unbolted, and 2 edge bolts on each side of the joint; finally, the last 4 bottom bolts were unbolted, and the bottom metal plate was removed.



**Figure 3.** Degradation of the splice connection of the S4 steel specimen by unbolting bolts.

The name of each measurement .csv file in the database has format **IMP\_S\_B.csv**, where:

- **IMP** indicates on the type of impact (“PULSE” – short impulse, or “SWP” – short wave impact, sweep type signal with duration 0.05 s);



**Figure 4.** Types of impact: wave action (left) and short impulse (right).

- **S** – indicates the specimen number in accordance with Figure 1;
- **B** is the number of the bolts in the investigated splice connection.

For example, the measurement designation PULSE\_S4\_8.csv indicates that the measurement was carried out for the specimen S4 in the state of connection with 8 bolts, under impulse action. And the measurement designation SWP\_S1\_12.csv indicates that the measurement was carried out for the specimen S1, which has 12 bolts in the connection, under short sweep type impact.

Each **SWP\_S\_B.csv** file has the following **structure**:

Columns													
A	B	C	D	E	F	G	H	I	J	K	L	M	N
Time, s	Short sweep impact	Measurements of the sensor 1						Measurements of the sensor 2					
		on axes:						on axes:					
		X	Y	Z	GX	GY	GZ	X	Y	Z	GX	GY	GZ

Each **PULSE\_S4\_B.csv** file has the following **structure**:

Columns														
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Time, s	Pulse impact	–	Measurements of the sensor 1						Measurements of the sensor 2					
			on axes:						on axes:					
			X	Y	Z	GX	GY	GZ	X	Y	Z	GX	GY	GZ

The structure's response was measured in three directions, namely, X, Y, and Z (see Figure 2), using two 3D accelerometers and around three axes, namely, GX, GY, and GZ, using two 3D gyroscopes, thus providing 6D space measurements.