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SUPPLEMENTARY LABORATORY INVESTIGATIONS OF MODERN PLASTIC-POLYMER FISHPLATES FOR RAIL JOINTS

Purpose. The authors' goal is to determine the behavior of insulated rail joints with polymer-composite fishplates without glueing in the consideration of dynamic loadings regarding to own laboratory tests. In this paper they introduce the applied measurement opportunities. **Methodology.** Dynamic (fatigue) bending tests were performed by insulated rail joints assembled with plastic-polymer fishplates. The special laboratory measurements are related to digital picture/video measurement technique and assessment method executed by GOM hardware and software, as well as computer tomography according to laboratory bending tests. **Findings.** In previous papers the authors published the results of glued-insulated rail joints, in this period they continued their research with the investigation of rail joints with plastic-polymer fishplates without glueing. They tested two different types of rail fishplates made of plastic-polymer material. For the rail joints with fishplates but without glueing, the authors applied special measurement techniques by GOM products (Tritop, Aramis) that enable high precision digital measurement techniques with spectacular visualization results. The computer tomography records ensure the opportunity to be able to receive information about inner crackings and faults of plastic-polymer fishplates, with also high precision measurements. The assessment method has to be developed for these specific measurement methodologies to be able to compare the results and define scientific statements. **Originality.** Up to now any researcher and research group have been dealing with insulated rail joints with special plastic-polymer fishplates without glueing applied mentioned special techniques, no one determined the exact deterioration process of these joints, as well as the crack growing phenomenon in the cross section of the fishplates. **Practical value.** The research team of the authors had the possibility to see into the details of glass-fibre reinforced resin bonded plastic fishplates during laboratory tests, as well as they publish timely information in the consideration of their laboratory tests' results. This result can be applied in railway engineering at all stages: design, construction, maintenance&operation in the future.

Keywords: laboratory tests; glass-fibre reinforced plastic; fishplate; rail joint; glue

Purpose

The authors' aim is to define the behavior of insulated rail joints with glass-fibre reinforced plastic fishplates, as well as with and without glue material (between rails and fishplates) regarding to static and dynamic loadings in the consideration of own laboratory tests.

In the authors' previous article [43] the purpose and working mechanism of glued-insulated rail joints were determined.

Now the special information related to plastic-polymer material and structures is shortly summarized.

Composite materials or composites are useful materials produced from two or more components with very different physical and chemical characteristics. New material can be made with compound of these parts. Therefore individual characteristics are able to be guaranteed by combination of these components [30]. From other viewpoint: composite material can be given as a combination of a matrix and a reinforcement, which when mixed enable properties better to the properties of the individual parts. In the case of a composite, the reinforcement is the so called fibres and is applied to strenghten the matrix in terms of strength and stiffness [49].

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In the aspect of composite materials several structures can be differentiated [33]:

- particle-reinforced,
  - large particle,
  - dispersion-strengthened,
- fibre-reinforced
  - continuous (aligned),
  - discontinuous (short),
    - aligned,
    - random oriented,
- structural
  - laminates,
  - sandwich panels.

Fibre material can be the followings [19, 31]:

- glass,
- carbon,
- aramid,
- basalt,
- etc.

In case of the authors' research the material of railway fishplates is glass-fibre reinforced resin-bonded plastic, in that the reinforcement is glass-fibre, the matrix is resin.

The advantages of glass-fibre reinforced plastic are the followings (compared to other materials):

- high strength [11, 26],
- high specific modulus of elasticity [11, 33],
- low weight [10, 11, 26, 33],
- high strength to weight ratio [19, 28],
- high stiffness to weight ratio [28],
- better impact characteristics [28],
- high damping [12],
- low thermal expansion [12],
- good corrosion resistance [13, 19, 28, 33],
- good moisture resistance [19],
- good resistance to heat and cold [19],
- good electrical insulation [15, 19, 21],
- nonmagnetic [21],
- good thermal insulation [15, 19],
- resistance to chemical and microbiological attacks [10],
- good dimensional stability [12, 19],
- design flexibility [28],
- recyclable [45, 46],
- cost-effectiveness [10, 18, 19, 26].

There are some disadvantages:

- more expensive than traditional materials [13],
- weakness (in case of unidirectional glass-fibre reinforced plastic) [21],
- anisotropic and non-homogeneous directional qualities [47],
- brittle behaviour [47],
- it needs special machining technology [10, 19, 26, 30] and special tools because of e.g. laminating problems during boring, milling, grinding and cutting:
  - CVD (chemical vapor deposition) diamond coated tools and milling tools [32],
  - water jet cutting, CO2 jet cutting [32],
  - high speed cutting [32],
  - laser cutting [19], carbon dioxide (CO2) laser, neodymium-doped yttrium aluminium garnet (Nd:YAG) laser fibre and disk lasers for cutting [19],
  - CNC milling [52],
  - HSS and carbide drill bit [52],
  - PCD (poly crystalline diamond) [33],
  - making holes with fine blanking procedure instead of boring [12],
  - ultrasonic drilling, laser drilling and water-jet drilling [12],
  - grinding with CBN wheel in dry condition, and with synthetic and emulsion coolants [18].

Glass-fibre reinforced plastic materials can be applied in many fields:

- car (vehicle) industry [13],
- aircraft industry [13, 30],
- aerospace industry [13, 15, 32],
- marine application [15, 52], naval industries [9],
- machine industry [30, 47],
- oil industries [33]
- defense indusrty [15],
- electrical industry [15],
- electronic industry [15],
- in seawater and sea sand concrete environment [31],
- subsea and offshore application [29],
- transport sector [15],
- agriculture and food industries [15],
- medical devices [13],
- sport goods [33], sport equipments [12],
- public health [15],
- housing [15],
- pipes [23],

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- surveillance equipment [21],
- other special structures:
  - lightweight footbridge [21],
  - military footbridge [22],
  - asphalt pavements [25],
  - orthotropic steel bridge surfacings [25],
  - composite floor system [14],
  - rotor blades of wind turbine [16],
  - wind power plant [52],
  - railway bogies [27],
  - many civil engineering applications [8, 13],
  - etc.

Here are some methods applied during research related to glass-fibre materials:

- laboratory tests (mechanical tests with/without accelerated corrosion tests, etc.):
  - accelerated corrosion tests, different pH and temperatures, different durations [31] to test the long-term durability of basalt- and glass-fibre reinforced polymer bars in seawater and sea sand concrete (SWSSC) environment,
  - scanning electron microscope [31],
  - X-ray tests [31],
  - energy dispersive X-ray spectroscopy (EDS) [31],
  - tensile and Differential Scanning Calorimetry (DSC) testing [8],
  - tension, shear tests [24, 38, 42, 43,]
  - ‘fracture’ tests [51, 54],
  - micrographic fracture analysis [54],
  - electrical conductivity tests [11],
  - acoustic emission tests, Active NDT (non-destructive testing) methods, like ultrasonic or radiographic testing, need an active external source, which introduces energy into the system in the form of an acoustic wave [17],
  - Cooper fatigue tests (asphalt pavements) [25],
  - tests with riveted joints [47],
  - ultrasonic C scan testing and image analysis [12],
  - bending and hygrothermal aging [20],
  - moisture absorption (Fickian diffusion stage) [20],
  - bending tests of composite slab [14],
- FEM modelling [27],
- FEM: predict the anisotropy and non-linear behaviour of glass fibre reinforced plastics [9],
- FEM and Digital Image Correlation (DIC) and strain maps in the test samples [47],

In previous research period the authors published their results related to the areas below [24, 38, 39, 40, 41, 42, 43, 44]:

- laboratory tests:
  - static shearing tests of glue material,
  - static 3-point bending tests of glued-insulated rail joints with steel and polymer-composite fishplates, as well as with plastic fishplates but without glueing,
  - dynamic (fatigue) tests of glued-insulated rail joints with steel and polymer-composite fishplates,
  - axial pulling tests of glued insulated rail joints with polymer-composite fishplates,
- field tests in real railway tracks:
  - evaluation of diagrams of track geometry recording car,
  - straightness tests executed by STRAIGHT-EDGE tool.

In this new research period the authors deal with only plastic-polymer fishplates in insulated rail joints, i.e. without glueing. There will be tests related to not only fishplates, but material tests with the cut specimens from the fishplates.

Two types of glass-fibre reinforced fishplates (fit to 54E1 rail profile) are available for laboratory tests:

- type I: structural, laminated polymer (Fig. 1),
- type II: combination of fibre-reinforced polymer with continuous (aligned) and discontinuous, random oriented structure (Fig. 2).

In this paper the authors summarize the up-to-date laboratory measurement possibilities and their initial results of plastic-polymer fishplates that are detailed in following sections. Material tests have not been introduced, yet, only in the following publications in 2020.

This paper is the continuation of the authors previous papers [24, 38, 39, 40, 41, 42, 43, 44].

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Fig. 1. Laboratory test assembly with fishplate type I

Fig. 2. Laboratory test assembly with fishplate type II

Methodology

Dynamic (fatigue) bending tests were performed by insulated rail joints assembled with plastic-polymer fishplates. The auhors applied special laboratory measurements that are related to digital picture/video measurement technique and assessment method executed by GOM hardwares and softwares, as well as computer tomography according to laboratory bending tests.

In the following the details of used methodologies and connecting characteristics, parameters are described.

The parameters of investigated fishplates (where type I and II are not specified the data are related to both):

- length: 900 mm,
- height 108 mm,
- width: 40 mm,
- number of holes: 6,
- geometrical patterns of bolt (screw) holes: according to the Hungarian regulations (40-190-150-140-150-190-40 mm from the end of the fishplate),
- diameter of holes: 28 mm,
- reinforce material: glass-fibre,
- matrix material: resin,
- material structure:
  - type I: structural, laminated polymer,
  - type II: combination of fibre-reinforced polymer with continuous (aligned) and discontinuous, random oriented structure.
- bolt (screw) characteristics:
  - diameter: 27 mm (for fishplate type I), 24 mm (for fishplate type II),
  - material property: 8.8 (i.e. tensile strength is min. 800 MPa, yield strength is min. 640 MPa).

Properties of endpost material:

- thickness: 4 mm,
- material: glass-fibre reinforced plastic,
- for rail profile: 54E1 (UIC54).

Properties of applied rails:

- profile: 54E1 (UIC54),
- length: approx. 2×750 mm,
- steel grade: R260 (900A),
- hardness: 260 HBW.

Characteristics of 3-point dynamic bending tests:

- actuator type: BiSS 300 kN,
- bay length: 1200 mm,
- supports: 2 inelastic steel supports with knuckles,
- rail fasteners: Vossloh Skl24 type,
- Fmin: 10 kN,
- Fmax: 136 kN,
- loading frequency: 2 Hz,
- registered values:
  - elapsed time in sec unit,
  - force in kN unit,
  - deformation in vertical plane in mm unit,
  - number of loading cycles.

As mentioned earlier, special modern measurement techniques were applied:

- digital picture/video recording and connecting data processing methods:
  - GOM Tritop,
  - GOM Aramis,
- computer tomograpgy.

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The authors planned test series with the following steps:

i) initial state recordings (i.e. before fatigue),
   a. make 3D computer tomography (Fig. 3) models of the middle section of fishplates (between two middle holes),
   b. assemble the rail joints,
   c. record the force vs. vertical displacement (or deformation, stress, strain, etc.) functions with load cell and LVDT, GOM Tritop (Fig. 4), GOM Aramis (Fig. 5) with static and short dynamic tests,

ii) fatigue test with 500,000 loading cycles (or until failure),

iii) state recordings after fatigue,
   a. disassemble the rail joint,
   b. make 3D computer tomography models of the middle section of fishplates (between two middle holes),
   c. reassemble the rail joints,
   d. record the force vs. vertical displacement (or deformation, stress, strain, etc.) functions with load cell and LVDT, GOM Tritop, GOM Aramis with static and short dynamic tests,

iv) fatigue test with 500,000 loading cycles (or until failure),

v) etc.

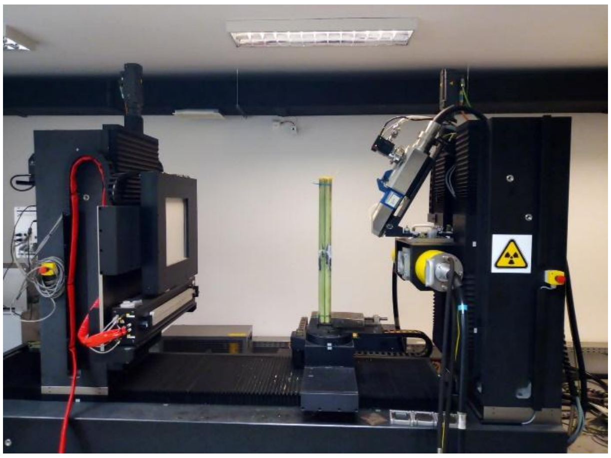

Fig. 3. Computer tomography machine (type: Yxilon Modular) and the measured fishplates

The steps ‘iii’…’iv’ should be repeated until altogether 3.5 million loading cycles (plan) for 3-3 pieces of rail joints (i.e. 3 specimens with fishplate type I and other 3 with type II).

The results from the initial stage (before fatigue), as well as after each 500,000 loading cycles (after fatigue stages) can be compared together. In this way the crack/failure growing processes are able to be determined and recorded related to the two different fishplates as a function of loading cycles.

In the Findings chapter the authors detail their relevant results.

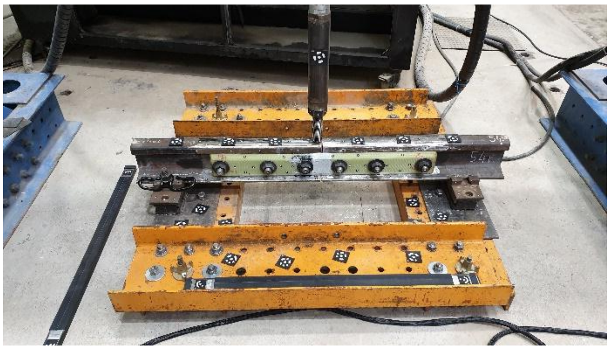

Fig. 4. Test assembly, measurement with GOM Tritop

Fig. 5. Test assembly, measurement with GOM Aramis

Findings

In previous papers [24, 38, 39, 40, 41, 42, 43, 44] the authors published the results of glued-insulated rail joints, in this period they continued their research with the investigation of rail joints with plastic-polymer fishplates without glueing.

They tested two different types of rail fishplates made of plastic-polymer material. For the rail joints with fishplates but without glueing, the authors applied special measurement techniques by GOM products (Tritop, Aramis) that enable high precision digital measurement techniques with spectacular visualization results. The computer tomography records ensure the opportunity to be able to receive information about inner crackings

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and faults of plastic-polymer fishplates, with also high precision measurements. The assessment method has to be developed for these specific measurement methodologies to be able to compare the results and define scientific statements.

By this time the following results were obtained with 1-1 pieces of rail joints:

- a pre-fatigue tests, i.e. step ’i’,
- post-fatigue tests, i.e. step ’ii’…’iii’, until approximately 10,000 loading cycles.

The reason of only approx. 10,000 loading cycles were applied the fact the fishplates partly or full failured:

- fishplate type I: partly failure after 10,000 cycles (one of the fishplate pair is damaged in the middle cross section at the top line),
- fishplate type II: failure after 7,331 cycles.

Figures 6-7 illustrate the rail joints after 1st loading period.

Fig. 6. Insulated rail joint with fishplate type I after 10,000 loading cycles (the seeable failure was only one fishplate, in the other not)

Fig. 7. Insulated rail joint with fishplate type II after 7,331 loading cycles (both fishplates damaged)

In Figures 8-9 the typical loading curves (hysteresis) can be seen recorded by original software of BiSS hydraulic actuator.

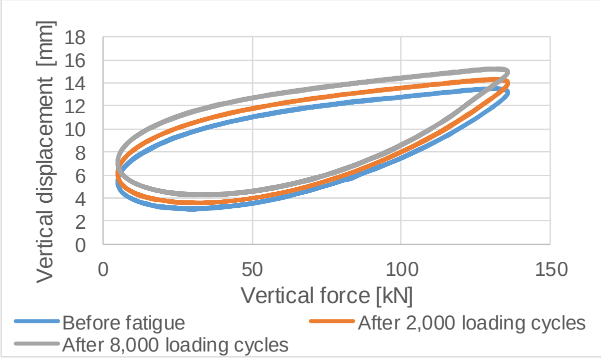

Fig. 8. Typical hysteresis curves of insulated rail joint with fishplate type I

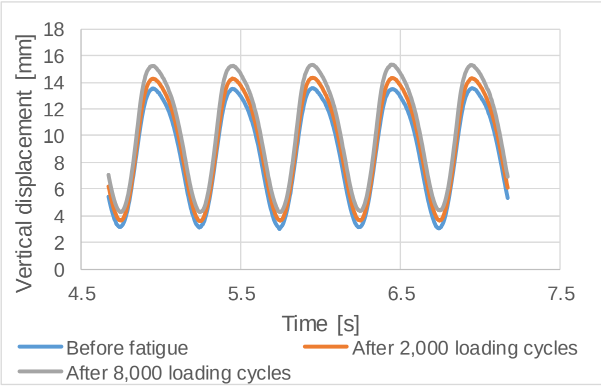

Fig. 9. Typical vertical displacement curves of insulated rail joint with fishplate type I

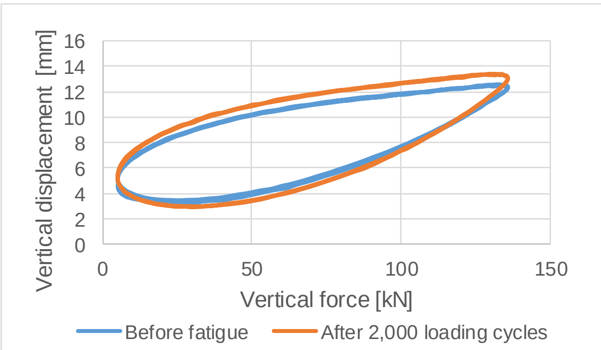

Fig. 10. Typical hysteresis curves of insulated rail joint with fishplate type II

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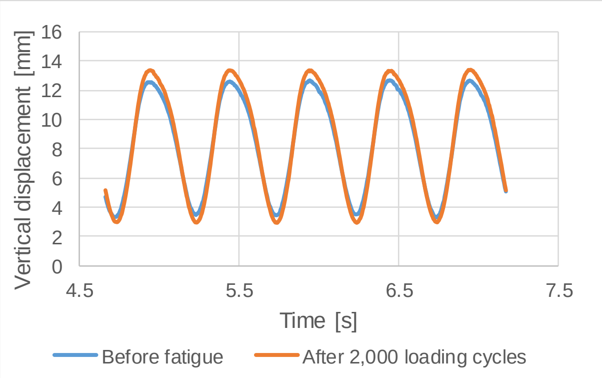

Fig. 11. Typical vertical displacement curves of insulated rail joint with fishplate type II

Figures 8-11 show that the higher the number of (elapsed) loading cycles, the higher the measurable vertical displacement. It is a very trivial behaviour of engineering structures during (and/or after) fatigue test.

The authors demonstrate some of the special measurement results obtained by GOM technology and computer tomography (Fig. 12-15).

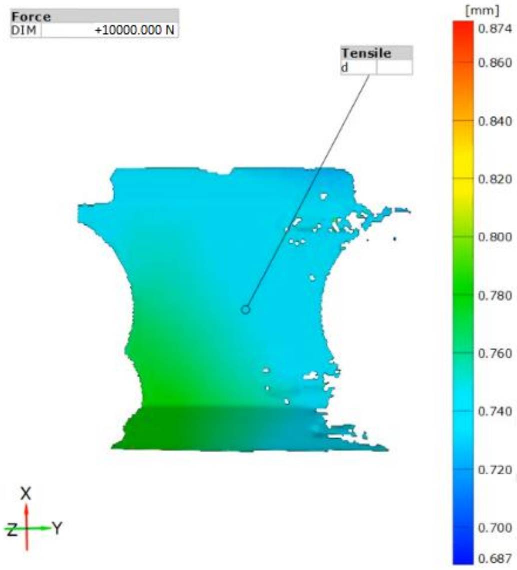

Fig. 12. Measured displacement (in vertical plane) of insulated rail joint's middle with fishplate type I before fatigue at 10 kN vertical loading – recorded by GOM Aramis (the picture is upside down)

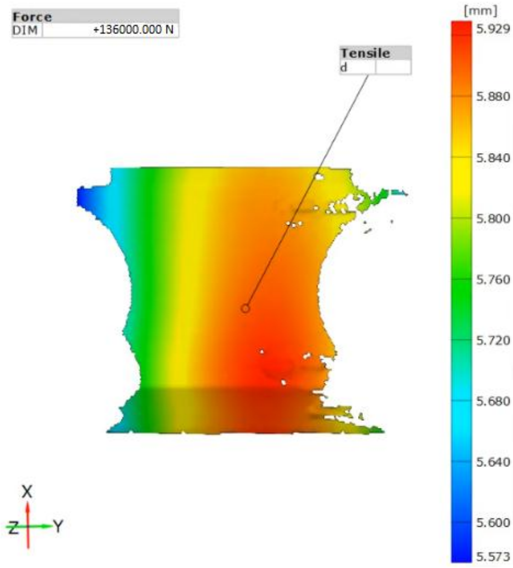

Fig. 13. Measured displacement (in vertical plane) of insulated rail joint's middle with fishplate type I before fatigue at 136 kN vertical loading – recorded by GOM Aramis (the picture is upside down)

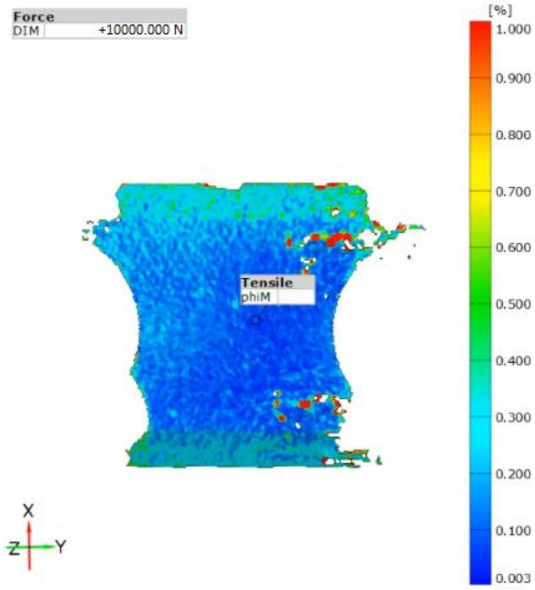

Fig. 14. Measured Mises strain (in vertical plane) of insulated rail joint's middle with fishplate type I before fatigue at 10 kN vertical loading – recorded by GOM Aramis (the picture is upside down)

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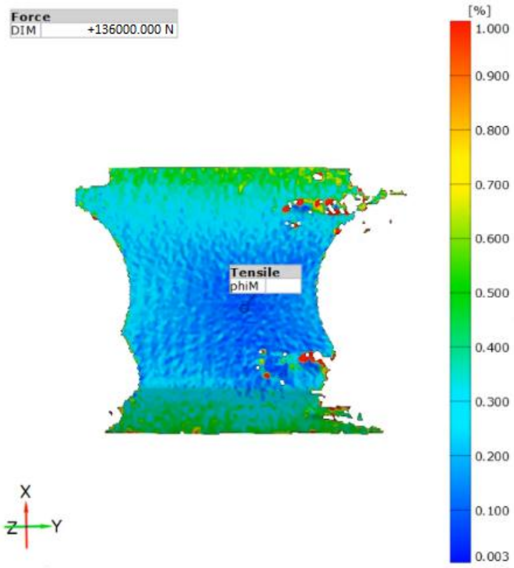

Fig. 15. Measured Mises strain (in vertical plane) of insulated rail joint's middle with fishplate type I before fatigue at 136 kN vertical loading – recorded by GOM Aramis (the picture is upside down)

It can be stated – regarding Fig. 12-15 – that measurement technique ensured by GOM Aramis is adequate to determine e.g. displacement and strain values very high precision compared to a reference status (so called '0' stage, i.e. non-loaded stage). Every diagram recorded by this method shows the differences. The measurements were executed by 10 Hz sampling while the short dynamic loading was 0.1 Hz. It means that in 10 seconds there was only one full sinus loading cycle, during which 100 pictures were taken. The apparatus of applied, assembled GOM Aramis hardwares and software were able to offer approx. 900 shoots. Because of this fact one measurement took approx. 90 seconds. Fig. 12-15 are typical pictures from the 900 ones. In the future the 'after fatigue' stages have to be recorded to be able to compare the results. (Next to the showed values, the software is able to give not only the vertical, but the horizontal measurements, as well as Epsilon X and Y parameters – so called specific strain values.)

Figures 16-17 demonstrate some 3-D recordings of computer tomography tests.

Fig. 16. Inner failures of fishplate type II (sign 'a') in the middle part before fatigue (yellow surfaces), as well as after 7,331 loading cycles (red surfaces) – recorded by computer tomography

Fig. 17. Inner failures of fishplate type II (sign 'b' in the middle part before fatigue (yellow surfaces), as well as after 7,331 loading cycles (red surfaces) – recorded by computer tomography

Referring Fig. 16-17 the authors state that 3-D computer tomography is also adequate for definition inner faults (e.g. crackings, inclusions, etc.) with very high accuracy. The recordings are able to be compared to each other and the deterioration process can be determined by this methodology.

Originality and practical value

Up to now any researcher and research group have been dealing with insulated rail joints with special plastic-polymer fishplates without glueing applied mentioned special techniques, no one determined the exact deterioration process of these joints, as well as the crack growing phenomenon in the cross section of the fishplates. The research

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team of the authors had the possibility to see into the details of glass-fibre reinforced resin bonded plastic fishplates during laboratory tests, as well as they publish timely information in the consideration of their laboratory tests' results. This result can be applied in railway engineering at all stages: design, construction, maintenance&operation in the future.

Up to now the laboratory measurements with GOM Tritop procedure and the data from those have not been processed yet, but the authors would like to execute it in the future, as well as publish these results.

The authors think that the largest challenge will be the development the data processing and evaluation procedure for both techniques (GOM techniques: Tritop and Aramis, as well as computer tomography).

E.g. in case of GOM Aramis some special points have to be marked before the short dynamic loading during this kind of measurements, after that data have to be filtered/determined from the database and diagrams, figures should be drawn. It means that the change of the behaviour of the fishplated joints can be assessed by usage of the trend functions related to the results from the measurements at different time, i.e. steps (from i) to v), see Section 'Methodology'). These special marked points can be the following on the fishplates:

- one point (or more points) from the above zone of the fishplate,
- one point (or more points) from the middle zone of the fishplate,
- one point (or more points) from the below zone of the fishplate.

The authors have to mention that in case of GOM Aramis the 'points' can be ranges (see Fig. 7 and Figures 12-15). The only requirement to have to be fulfilled: these points or ranges should be able to localized/seen in every recorded picture to be able to define the changes of the parameters related to them.

The second possibility is the GOM Tritop (see Fig. 4). It is a technique with usage of reference points (i.e. without movements/displacements during the measurements), as well as measured points (i.e. they have movements/displacements during the measurements compared to reference points). GOM Tritop gives the opportunity to be able to define the displacement vectors without usage of e.g. Matlab programming. As the authors mentioned, up to now the data processing and assessment have not been performed.

The third possibility is the computer tomography. The recorded 3-D models from computer tomography measurements, the evolution of the crackings or any irregularities inside (or naturally on the surfaces) of the fishplates can be localised and determined. It means that e.g. the length values or maybe the volume (in mm^3 unit) of the faults (i.e. air inside the fishplates), or the number and location of the broken glass fibres are able to be defined. It should be mentioned that computer tomography machine at Széchenyi István University is able to make recordings with limited dimensions, it is the reason the authors focus on the middle part of the fishplates (remark: the highest stress and strain values are in this zone due to the static model and the supports of the 'beam'). The authors have an initial result with this procedure. The volume of the faults (air) related to the Figures 16-17 are the followings:

- at the initial stage (i.e. before fatigue test): 3,000 mm3,
- after 7,331 loading cycles: approx. 18,000 mm^3.

It means that the volume of the faults increased the sixfold of the initial after 7,331 loading cycles (after this quantity of loading cycles the fishplates – type II – went broke).

There are some aspects the authors have to consider in the continuation of their research:

- specimens should be cut from the fishplates and bending, tensile tests have to be executed (according to the European standards),
- from these measurements the material characteristics can be defined,
- the performed bending tests with full scale fishplates (see steps in the Methodology chapter) are able to ensure the change of the vertical displacement (deformation) of the rail joints as a function of loading cycles, the elasticity parameters can be calculated (maybe E×I and/or G×A values, Poisson ratio, sigma-epsylon – stress-strain –, etc.),
- the results will be adequate to compare the behaviour of insulated rail joints with and without glueing, as well as the insulated rail joints with

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glass-fibre reinforced fishplates and traditional steel fishplates,

In the following research – mainly in the preparation of PhD thesis of Attila Németh – the below techniques, methodologies and aspects, have to be considered related to insulated and glued insulated rail joints with glass-fibre reinforced fishplates:

- evaluation of geometrical deterioration of ballasted railway tracks [34, 35, 36, 37],
- dynamic effects of the railway track (and e.g. turnouts) and vehicles, as well as irregular movements of rail vehicles [3, 4, 5, 6, 7, 48, 50, 53],
- calculation method of stress-strain rate in the railway layer structures [1, 2].
- This paper is the continuation of the authors previous papers [24, 38, 39, 40, 41, 42, 43, 44].

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ДОДАТКОВІ ЛАБОРАТОРНІ ДОСЛІДЖЕННЯ СУЧАСНИХ ПЛАСТИКОВО-ПОЛІМЕРНИХ НАКЛАДОК ДЛЯ РЕЙКОВИХ З’ЄДНАНЬ

Мета. У цій статті передбачено визначити поведінку ізольованих рейкових з’єднань із полімер-композитними накладками без склеювання під час розгляду динамічних навантажень щодо власних лабораторних випробувань. Автори представляють прикладні можливості вимірювання. **Методика.** Динамічні (втомні) випробування на вигин було проведено за допомогою ізольованих рейкових з’єднань, зібраних із пластикових полімерних рейкових накладок. Спеціальні лабораторні випробування пов’язані з технікою ви-мірювання та методом оцінки цифрового зображення/відео, що виконані апаратними і програмними засоба-ми GOM, а також з комп’ютерною томографією відповідно до лабораторних випробувань на вигин. **Резуль-тати.** У попередніх роботах автори публікували результати дослідження клейових рейкових стиків, зараз вони продовжують дослідження рейкових стиків із пластиково-полімерними накладками без склеювання. Було випробувано два різних типи рейкових накладок, виготовлених із полімерно-пластикового матеріалу. Для рейкових стиків із накладками без склеювання автори використали спеціальні методи вимірювання, ро-зроблені GOM (Tritop, Aramis), які дозволяють застосовувати високоточні цифрові вимірювання з вражаю-чими результатами візуалізації. Записи комп’ютерної томографії забезпечують можливість отримувати інформацію про внутрішні тріщини та пошкодження пластиково-полімерних рейкових накладок, а також про вимірювання з високою точністю. Метод оцінки повинен бути розроблений для цих конкретних методик вимірювання, щоб мати можливість порівнювати результати і визначати наукові твердження. **Наукова новизна.** До цього часу дослідники й дослідницькі групи займалися вивченням ізольованих рейко-вих стиків зі спеціальними пластиково-полімерними накладками без склеювання, застосовуючи згадані спе-ціальні методи; ніхто не визначав точний процес руйнування цих з’єднань, а також явище збільшення трі-щин у поперечному перерізі рейкових накладок. **Практична значимість.** Дослідницька група авторів мала можливість ознайомитися з деталями рейкових накладок, посилених скловолокном, склеєних смолою під час лабораторних випробувань, а також опублікувати своєчасну інформацію про результати лабораторних випробувань. Ці результати в майбутньому можна застосовувати в залізничному машинобудуванні на всіх етапах: проєктування, будівництво, технічне обслуговування й експлуатація.

Ключові слова: лабораторні випробування; армований склопластик; рейкові накладки; рейковий стик; клей

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ДОПОЛНИТЕЛЬНЫЕ ЛАБОРАТОРНЫЕ ИССЛЕДОВАНИЯ СОВРЕМЕННЫХ ПЛАСТИКОВО-ПОЛИМЕРНЫХ НАКЛАДОК ДЛЯ РЕЛЬСОВЫХ СОЕДИНЕНИЙ

Цель. В данной статье предусмотрено определить поведение изолированных рельсовых соединений с полимер-композитными накладками без склеивания при рассмотрении динамических нагрузок в отношении собственных лабораторных испытаний. Авторы представляют прикладные возможности измерения. **Методика.** Динамические (усталостные) испытания на изгиб были проведены с помощью изолированных рельсовых соединений, собранных из пластиковых полимерных рельсовых накладок. Специальные лабораторные испытания связаны с техникой измерения и методом оценки цифрового изображения/видео, выполняемыми аппаратными и программными средствами GOM, а также с компьютерной томографией в соответствии с лабораторными испытаниями на изгиб. **Результаты.** В предыдущих работах авторы публиковали результаты исследования клеевых рельсовых стыков, сейчас они продолжают исследования рельсовых стыков с пластиково-полимерными накладками без склеивания. Были испытаны два различных типа рельсовых накладок, изготовленных из полимерно-пластикового материала. Для рельсовых стыков с накладками без склеивания авторы использовали специальные методы измерения, разработанные GOM (Tritop, Aramis), которые позволяют применять высокоточные цифровые измерения с впечатляющими результатами визуализации. Записи компьютерной томографии обеспечивают возможность получать информацию о внутренних трещинах и повреждениях пластиково-полимерных рельсовых накладок, а также об измерениях с высокой точностью. Метод оценки должен быть разработан для этих конкретных методик измерения, чтобы иметь возможность сравнивать результаты и определять научные утверждения. **Научная новизна.** До настоящего времени исследователи и исследовательские группы занимались изучением изолированных рельсовых стыков со специальными пластиково-полимерными накладками без склеивания, применяя упомянутые специальные методы; никто не определял точный процесс разрушения этих соединений, а также явление увеличения трещин в поперечном сечении рельсовых накладок. **Практическая значимость.** Исследовательская группа авторов имела возможность ознакомиться с деталями рельсовых накладок, усиленных стекловолокном, склеенных смолой во время лабораторных испытаний, а также опубликовать своевременную информацию о результатах лабораторных испытаний. Эти результаты в будущем можно применять в железнодорожном машиностроении на всех этапах: проектирование, строительство, техническое обслуживание и эксплуатация.

Ключевые слова: лабораторные испытания; армированный стеклопластик; рельсовые накладки; рельсовый стык; клей

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