KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
UNIVERSITAS NEGERI SEMARANG
LEMBAGA PENELITIAN DAN PENGABDIAN KEPADA MASYARAKAT
Gedung Prof. Dr. Retno Sriningsih Satmoko, Kampus Sekaran, Gunungpati, Semarang 50229
Telp/Fax (024) 8508087, (024) 8508089
Laman: http://lppm.unnes.ac.id Email: lppm@mail.unnes.ac.id

SURAT PERJANJIAN
PELAKSANAAN PENELITIAN KERJASAMA
DANA DIPA UNNES TAHUN 2021
Nomor: 14.26.4/UN37/PPK.3.1/2021

Pada hari ini Senin tanggal Dua puluh enam bulan April tahun Dua ribu dua puluh satu, kami yang bertandatangan di bawah ini:

1. Dr. Suwito Eko Pramono M. Pd.	:	**Pejabat Pembuat Komitmen** Lembaga Penelitian dan Pengabdian Kepada Masyarakat Universitas Negeri Semarang yang berkedudukan di Semarang, berdasarkan Keputusan Rektor Universitas Negeri Semarang Nomor : B/3/UN37/HK/2021 tanggal 4 Januari 2021, dalam hal ini bertindak untuk dan atas nama KPA Universitas Negeri Semarang, untuk selanjutnya disebut **PIHAK PERTAMA**;
2. Dr RINI KUSUMAWARDANI S. T., M. T., M. Sc	:	Dosen pada FT Universitas Negeri Semarang, dalam hal ini bertindak sebagai Pengusul dan Ketua Pelaksana Penelitian Kerjasama Tahun Anggaran 2021 untuk selanjutnya disebut **PIHAK KEDUA**

PIHAK PERTAMA dan **PIHAK KEDUA** secara bersama-sama bersepakat mengikatkan diri dalam suatu Perjanjian Pelaksanaan Penelitian Kerjasama dengan ketentuan dan syarat-syarat yang diatur dalam pasal-pasal sebagai berikut.

PASAL 1
Dasar Hukum

Perjanjian penugasan ini berdasarkan kepada:

1. Peraturan Menteri Riset, Teknologi dan Pendidikan Tinggi Republik Indonesia Nomor 23 Tahun 2015 tentang Organisasi dan Tata Kerja Universitas Negeri Semarang.
2. Peraturan Menteri Keuangan Nomor 32/PMK.02/2018 tentang Standar Biaya Masukan Tahun Anggaran 2018 Nomor 511.
3. Keputusan Rektor Universitas Negeri Semarang Nomor : 302/P/2018 tanggal 26 Juni 2018, tentang Pemberhentian dan Pengangkatan Pimpinan Lembaga dan Pimpinan Pascasarjana Antar waktu Universitas Negeri Semarang.
4. Keputusan Rektor Universitas Negeri Semarang Nomor B/3/UN37/HK/2021 tanggal 4 Januari 2021, tentang Pengangkatan Pejabat Perbendaharaan/Pengelola Keuangan Tahun Anggaran 2021 Universitas Negeri Semarang.
5. Surat Keputusan Rektor Universitas Negeri Semarang Nomor : B/335/UN37/HK/2021 tanggal 12 April 2021 tentang Penetapan Pelaksanaan Penelitian dan Pengabdian Kepada Masyarakat Universitas Negeri Semarang Tahun 2021.
6. Daftar Isian Pelaksanaan Anggaran (DIPA) Universitas Negeri Semarang (UNNES) Nomor DIPA : SP DIPA-023.17.2.677507/2021, tanggal 23 November 2020.

PASAL 2
Ruang Lingkup Perjanjian

(1) **PIHAK PERTAMA** memberi tugas kepada **PIHAK KEDUA**, dan **PIHAK KEDUA** menerima tugas tersebut untuk melaksanakan Penelitian Kerjasama tahun 2021 dengan judul "STRUCTURAL HEALTH MONITORING OF MERAH PUTIH AMBON CABLE-STAYED BRIDGES SUBJECTED TO NEAR FAULT EARTHQUAKE"

(2) **PIHAK KEDUA** bertanggungjawab penuh atas pelaksanaan, administrasi dan keuangan atas pekerjaan sebagaimana dimaksud pada ayat (1) dan berkewajiban menyerahkan semua bukti-bukti pengeluaran serta dokumen pelaksanaan lainnya dalam hal diperlukan oleh **PIHAK PERTAMA**.

PASAL 3
Dana Penelitian

(1) Besarnya dana untuk melaksanakan penelitian dengan judul sebagaimana dimaksud pada Pasal 2 adalah sebesar Rp. 100.000.000,00 (seratus juta Rupiah) sudah termasuk pajak.

(2) Dana Penelitian sebagaimana dimaksud pada ayat (1) dibebankan pada Daftar Isian Pelaksanaan Anggaran UNNES Nomor SP DIPA-023.17.2.677507/2021, tanggal 23 November 2020.

PASAL 4
Tata Cara Pembayaran Dana Penelitian

(1) **PIHAK PERTAMA** akan membayarkan Dana Penelitian kepada **PIHAK KEDUA** secara bertahap dengan ketentuan sebagai berikut:

a. Pembayaran Tahap Pertama sebesar 70% dari total dana penelitian yaitu 70% x Rp. 100.000.000,00 = Rp. 70.000.000,00 (tujuh puluh juta Rupiah), yang akan dibayarkan oleh **PIHAK PERTAMA** kepada **PIHAK KEDUA** setelah mengunggah hasil revisi proposal yang sudah disahkan oleh Pejabat yang berwenang, RAB, dan instrumen penelitian ke SIPP

b. Pembayaran Tahap Kedua sebesar 30% dari total dana penelitian yaitu 30% x Rp. 100.000.000,00 = Rp. 30.000.000,00 (tiga puluh juta Rupiah), dibayarkan oleh **PIHAK PERTAMA** kepada **PIHAK KEDUA** setelah mengunggah Laporan Kemajuan, Laporan Akhir yang sudah disahkan oleh Pejabat yang berwenang, Catatan Harian, SPTB dan Laporan Penggunaan Anggaran pada SIPP **paling lambat tanggal 13 November 2021**

(2) Dana Penelitian sebagaimana dimaksud pada ayat (1) akan disalurkan oleh **PIHAK PERTAMA** kepada **PIHAK KEDUA** melalui rekening BNI atas nama Dr RINI KUSUMAWARDANI S. T., M. T., M. Sc dengan nomor rekening 0246581245

Pasal 5
Jangka Waktu

Jangka waktu pelaksanaan penelitian sebagaimana dimaksud dalam Pasal 2 sampai selesai 100%, adalah terhitung sejak **Tanggal 26 April** dan berakhir pada **Tanggal 13 November 2021.**

Pasal 6
Target Luaran

(1) **PIHAK KEDUA** berkewajiban untuk mencapai target luaran wajib seperti tersebut di bawah:
Luaran Wajib :
a. Implementation Arrangement (IA) (Sudah Jadi)
b. Publikasi di Jurnal internasional bereputasi terindeks pada database internasional bereputasi (Draft)
c. Sertifikat Visiting Profesor/Researcher/Guest Lecture (Sudah Jadi)
d. Presentasi di Seminar/Simposium/Lokakarya tingkat Internasional/Nasional tetapi tidak dimuat dalam p (Accepted)

(2) **Semua anggota peneliti** harus dimasukkan ke luaran wajib penelitian dan pada artikel **disebutkan nomor kontrak pada bagian "ucapan terimakasih".**

(3) **PIHAK KEDUA** berkewajiban untuk melaporkan perkembangan pencapaian target luaran sebagaimana dimaksud pada ayat (1) kepada **PIHAK PERTAMA.**

Pasal 7
Hak dan Kewajiban Para Pihak

(1) Hak dan Kewajiban **PIHAK PERTAMA**:
a. **PIHAK PERTAMA** berkewajiban untuk memberikan dana penelitian kepada **PIHAK KEDUA** dengan jumlah sebagaimana dimaksud dalam Pasal 3 dan dengan tata cara pembayaran sebagaimana dimaksud dalam Pasal 4;
b. **PIHAK PERTAMA** berhak untuk mendapatkan dari **PIHAK KEDUA** luaran penelitian sebagaimana dimaksud dalam Pasal 6.

(2) Hak dan Kewajiban **PIHAK KEDUA**:
a. **PIHAK KEDUA** berhak menerima dana penelitian dari **PIHAK PERTAMA** dengan jumlah sebagaimana dimaksud dalam Pasal 3 dan dengan tata cara pembayaran sebagaimana dimaksud dalam Pasal 4.
b. **PIHAK KEDUA** berkewajiban menyerahkan kepada **PIHAK PERTAMA** luaran wajib sebagaimana pada pasal 6

Pasal 8
Pelaksanaan Penelitian

(1) **PIHAK KEDUA** berkewajiban mengunggah hasil revisi proposal yang disahkan oleh Pejabat yang berwenang, RAB, dan instrumen penelitian ke SIPP dan menyerahkan *hardcopy* dokumen masing-masing 1 (satu) eksemplar **paling lambat tanggal 8 Mei 2021**

(2) **PIHAK KEDUA** berkewajiban mengisi Catatan Harian beserta mengunggah bukti-bukti kegiatan atau pengeluaran dana, laporan penggunaan anggaran, SPTB (70%), dan Laporan kemajuan ke SIPP serta menyerahkan *hardcopy* dokumen masing-masing 1 (satu) eksemplar **paling lambat 7 Oktober 2021**

(3) **PIHAK KEDUA** berkewajiban mengisi Catatan Harian beserta mengunggah bukti-bukti kegiatan atau pengeluaran anggaran 100%, Laporan Akhir, Poster, Artikel Ilmiah, Profil dan SPTB (100%) pada SIPP **paling lambat 13 November 2021**

(4) **PIHAK KEDUA** berkewajiban menyerahkan *Hardcopy* Catatan Harian, Laporan Akhir, Laporan Penggunaan Anggaran beserta bukti-bukti pengeluaran, artikel ilmiah masing-masing satu eksemplar kepada **PIHAK PERTAMA** paling lambat **31 Desember 2021**

(5) **PIHAK KEDUA** berkewajiban mengunggah bukti luaran wajib sebagaimana pada Pasal 6 paling lambat pada Tanggal **31 Agustus Tahun 2022** dengan status ***PUBLISHED***

(6) Laporan hasil Penelitian sebagaimana tersebut pada ayat (4) harus memenuhi ketentuan sebagai berikut:
a. Format font Times New Romans Ukuran 12 spasi 1,5
b. Bentuk/ukuran kertas A4;

c. Warna sampul (disesuaikan dengan ketentuan di panduan penelitian dan pengabdian kepada masyarakat tahun 2021)
d. Di bawah bagian sampul ditulis:

Dibiayai oleh:
Daftar Isian Pelaksanaan Anggaran (DIPA) Universitas Negeri Semarang
Nomor : SP DIPA-023.17.2.677507/2021, tanggal 23 November 2020, sesuai dengan
Surat Perjanjian Pelaksanaan Penelitian Dana DIPA UNNES Tahun 2021
Nomor 14.26.4/UN37/PPK.3.1/2021, tanggal 26 April 2021

Pasal 9
Monitoring dan Evaluasi

(1) **PIHAK PERTAMA** dalam rangka pengawasan akan melakukan Monitoring dan Evaluasi internal terhadap kemajuan pelaksanaan Penelitian Tahun Anggaran 2021
(2) **PIHAK KEDUA** selaku Ketua Pelaksana **wajib hadir** dalam kegiatan Monitoring dan Evaluasi internal, jika berhalangan wajib memberikan kuasa kepada anggota tim peneliti dalam judul yang sama.

Pasal 10
Penilaian Luaran

Penilaian luaran penelitian dilakukan oleh Komite Penilai/*Reviewer* Luaran sesuai dengan ketentuan yang berlaku.

Pasal 11
Penggantian Ketua Pelaksana

(1) Apabila **PIHAK KEDUA** selaku ketua pelaksana tidak dapat melaksanakan penelitian ini, maka **PIHAK KEDUA** wajib mengusulkan pengganti ketua pelaksana yang merupakan salah satu anggota tim kepada **PIHAK PERTAMA**.
(2) Perubahan terhadap susunan tim pelaksana dan substansi pelaksanaan penelitian ini dapat dibenarkan apa bila telah mendapat persetujuan tertulis dari **PIHAK PERTAMA**.
(3) Apabila **PIHAK KEDUA** tidak dapat melaksanakan tugas dan tidak ada pengganti ketua sebagaimana dimaksud pada ayat (1), maka **PIHAK KEDUA** harus mengembalikan dana penelitian kepada **PIHAK PERTAMA** yang selanjutnya disetor ke Kas BLU.
(4) Bukti setor sebagaimana dimaksud pada ayat (3) disimpan oleh **PIHAK PERTAMA.**

Pasal 12
Sanksi

(1) Apabila sampai dengan batas waktu yang telah ditetapkan untuk melaksanakan Kontrak Penelitian telah berakhir, **PIHAK KEDUA belum menyelesaikan** tugasnya dan atau **terlambat** mengirim dan mengunggah laporan Kemajuan, catatan harian, Surat Pernyataan Tanggungjawab Belanja (SPTB) dan Laporan akhir, maka **PIHAK KEDUA** dikenakan **sanksi denda sebesar 1‰ (satu permil)** untuk setiap hari keterlambatan sampai dengan **setinggi-tingginya 5% (lima persen)** terhitung dari tanggal jatuh tempo (13 November s.d. 31 Desember 2021)
(2) Apabila sampai dengan batas waktu tanggal **31 Desember 2021, PIHAK KEDUA tidak melaksanakan kewajiban** sebagaimana dimaksud dalam Pasal 8, maka **PIHAK KEDUA** dikenai **sanksi denda** berupa **mengembalikan dana 30% dari dana penelitiannya** ke Kas BLU dan **sanksi administratif tidak dapat mengajukan proposal penelitian dalam kurun waktu 2 (dua) tahun berturut-turut.**

(3) Apabila **PIHAK KEDUA** tidak dapat memenuhi luaran yang telah dijanjikan sebagaimana dimaksud dalam Pasal 6 ayat (1) sampai dengan tanggal **31 Agustus 2022** maka:
   a. **PIHAK KEDUA** dikenakan **sanksi denda** berupa **mengembalikan dana biaya publikasi sebesar 5%** dari total dana penelitian ke kas BLU
   b. **PIHAK KEDUA tidak dapat mengajukan proposal penelitian** pendanaan LPPM UNNES dalam kurun waktu **2 (dua) tahun berturut-turut baik sebagai Ketua maupun Anggota**

(4) Apabila **PIHAK KEDUA** tidak hadir dalam kegiatan Monitoring dan Evaluasi tanpa pemberitahuan sebelumnya kepada **PIHAK PERTAMA**, maka **PIHAK KEDUA tidak berhak menerima dana Tahap Kedua** sebesar 30%.

Pasal 13
Pembatalan Perjanjian

(1) Apabila dikemudian hari terhadap judul Penelitian sebagaimana dimaksud dalam Pasal 2 ditemukan adanya duplikasi dengan Penelitian lain dan/atau ditemukan adanya ketidakjujuran, itikad tidak baik, dan/atau perbuatan yang tidak sesuai dengan kaidah ilmiah dari atau dilakukan oleh **PIHAK KEDUA**, maka perjanjian Penelitian ini dinyatakan batal dan **PIHAK KEDUA** wajib mengembalikan dana penelitian yang telah diterima dari **PIHAK PERTAMA** yang selanjutnya akan disetor ke Kas BLU.
(2) Bukti setor sebagaimana dimaksud pada ayat (1) disimpan oleh **PIHAK PERTAMA**

Pasal 14
Pajak-pajak

(1) **PIHAK KEDUA** berkewajiban memungut dan menyetor pajak ke kantor pelayanan pajak setempat sesuai dengan ketentuan yang berlaku
(2) **PIHAK KEDUA** berkewajiban menyerahkan bukti pembayaran pajak kepada **PIHAK PERTAMA**

Pasal 15
Peralatan dan/alat Hasil Penelitian

(1) Hak kekayaan intelektual yang dihasilkan dari Pelaksana Penelitian diatur dan dikelola sesuai dengan peraturan dan perundang-undangan.
(2) Setiap publikasi, makalah dan/atau ekspos dalam bentuk apa pun yang berkaitan dengan hasil penelitian ini wajib mencantumkan **PIHAK PERTAMA** sebagai pemberi dana.
(3) Pencantuman nama PIHAK PERTAMA sebagaimana dimaksud pada ayat (2), paling sedikit mencantumkan nama Lembaga Penelitian dan Pengabdian kepada Masyarakat UNNES.
(4) Hasil penelitian berupa peralatan dan/atau peralatan yang dibeli dari kegiatan ini adalah milik negara, dan dapat dihibahkan kepada institusi/lembaga melalui Berita Acara Serah Terima (BAST)

Pasal 16
Integritas Akademik

(1) Pelaksana penelitian wajib menjunjung tinggi integritas akademik yaitu komitmen dalam bentuk perbuatan yang berdasarkan pada nilai kejujuran, kredibilitas, kewajaran, kehormatan, dan tanggung jawab dalam kegiatan penelitian yang dilaksanakan.
(2) Penelitian dilakukan sesuai dengan kerangka etika, humum dan profesionalitas, serta kewajiban sesuai dengan peraturan yang berlaku
(3) Penelitian dilakukan dengan menjunjung tinggi standar ketelitian dan integritas tertinggi dalam semua aspek penelitian.

Pasal 17
Keadaan Memaksa *(force majeure)*

(1) **PARA PIHAK** dibebaskan dari tanggung jawab atas keterlambatan atau kegagalan dalam memenuhi kewajiban yang dimaksud dalam Perjanjian Penugasan Pelaksanaan Penelitian disebabkan atau diakibatkan oleh kejadian di luar kekuasaan **PARA PIHAK** yang dapat digolongkan sebagai keadaan memaksa *(force majeure)*.

(2) Peristiwa atau kejadian yang dapat digolongkan keadaan memaksa *(force majeure)* dalam Perjanjian Penugasan Pelaksanaan Penelitian ini adalah bencana alam, wabah penyakit, kebakaran, perang, blokade, peledakan, sabotase, revolusi, pemberontakan, huru-hara, serta adanya tindakan pemerintah dalam bidang ekonomi dan moneter yang secara nyata berpengaruh terhadap Perjanjian Penugasan Pelaksanaan Penelitian.

(3) Apabila terjadi keadaan memaksa *(force majeure)* maka pihak yang mengalami wajib memberitahukan kepada pihak lainnya secara tertulis, selambat-lambatnya dalam waktu 7 (tujuh) hari kerja sejak terjadinya keadaan keadaan memaksa *(force majeure)*, disertai dengan bukti-bukti yang sah dari pihak berwajib dan **PARA PIHAK** dengan etiket baik akan segera membicarakan penyelesaiannya.

Pasal 18
Penyelesaian Sengketa

Apabila terjadi perselisihan antara **PIHAK PERTAMA** dan **PIHAK KEDUA** dalam pelaksanaan perjanjian ini akan dilakukan penyelesaian secara musyawarah dan mufakat, dan apabila tidak tercapai penyelesaian secara musyawarah dan mufakat maka penyelesaian dilakukan melalui proses hukum yang berlaku dengan memilih domisili hukum di Pengadilan Tinggi Semarang

Pasal 19
Lain-Lain

(1) **PIHAK KEDUA** menjamin bahwa penelitian dengan judul tersebut di atas belum pernah dibiayai dan/atau diikutsertakan pada Pendanaan Penelitian lainnya, baik yang diselenggarakan oleh instansi, lembaga, perusahaan atau yayasan, baik di dalam maupun di luar negeri.

(2) Segala sesuatu yang belum cukup diatur dalam Perjanjian ini dan dipandang perlu diatur lebih lanjut dan dilakukan perubahan oleh **PARA PIHAK**, maka perubahan-perubahannya akan diatur dalam perjanjian tambahan atau perubahan yang merupakan satu kesatuan dan bagian yang tidak terpisahkan dari Perjanjian ini.

Pasal 20
Penutup

Perjanjian ini dibuat dan ditandatangani oleh **PARA PIHAK** pada hari dan tanggal tersebut di atas, dibuat dalam rangkap 3 (tiga) dan bermeterai cukup sesuai dengan ketentuan yang berlaku, yang masing-masing mempunyai kekuatan hukum yang sama.

PIHAK PERTAMA	**PIHAK KEDUA**
Dr. Suwito Eko Pramono M. Pd.	**Dr RINI KUSUMAWARDANI S. T., M. T., M. Sc**
NIP. 195809201985031003	NIP. 197809212005012001

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
UNIVERSITAS NEGERI SEMARANG
LEMBAGA PENELITIAN DAN PENGABDIAN KEPADA MASYARAKAT
Gedung Prof. Dr. Retno Sriningsih Satmoko, Kampus Sekaran, Gunungpati, Semarang 50229
Telp/Fax (024) 8508087, (024) 8508089
Laman: http://lppm.unnes.ac.id Email: lppm@mail.unnes.ac.id

SURAT PERNYATAAN

Yang bertanda tangan dibawah ini:

Nama	:	Dr RINI KUSUMAWARDANI S. T., M. T., M. Sc
NIP	:	197809212005012001
Unit Kerja	:	FT Universitas Negeri Semarang

Dengan ini menyatakan bahwa Penelitian saya berjudul:

"STRUCTURAL HEALTH MONITORING OF MERAH PUTIH AMBON CABLE-STAYED BRIDGES SUBJECTED TO NEAR FAULT EARTHQUAKE"

yang dibiayai oleh DIPA (Daftar Isian Pelaksanaan Anggaran) Universitas Negeri Semarang Nomor: SP DIPA-023.17.2.677507/2021, tanggal 23 November 2020, dengan Surat Perjanjian Penugasan Pelaksanaan Penelitian Dana DIPA UNNES Tahun 2021 Nomor 14.26.4/UN37/PPK.3.1/2021, tanggal 26 April 2021, adalah **bersifat original dan belum pernah dibiayai oleh lembaga/sumber dana lain.**

Bilamana dikemudian hari ditemukan ketidak sesuaian dengan pernyataan ini, maka saya bersedia dituntut dan diproses sesuai dengan ketentuan yang berlaku dan mengembalikan seluruh biaya penelitian yang sudah diterima ke kas BLU.

Demikian pernyataan ini dibuat dengan sesungguhnya dan dengan sebenar-benarnya.

Semarang, 26 April 2021

Mengetahui,
Ketua LPPM UNNES

Dr. Suwito Eko Pramono M. Pd.
NIP. 195809201985031003

Yang menyatakan,
Ketua Pelaksana

Dr RINI KUSUMAWARDANI S. T., M. T., M. Sc
NIP. 197809212005012001

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
UNIVERSITAS NEGERI SEMARANG
LEMBAGA PENELITIAN DAN PENGABDIAN KEPADA MASYARAKAT
Gedung Prof. Dr. Retno Sriningsih Satmoko, Kampus Sekaran, Gunungpati, Semarang 50229
Telp/Fax (024) 8508087, (024) 8508089
Laman: http://lppm.unnes.ac.id Email: lppm@mail.unnes.ac.id

PERNYATAAN KESANGGUPAN PELAKSANAAN PENELITIAN

NOMOR: B/2149/UN37.3.1/PG/2021

Saya yang bertanda tangan di bawah ini :
Nama : Dr RINI KUSUMAWARDANI S. T., M. T., M. Sc
Alamat : Jl. Tegalsari Barat I/108 Semarang

Sehubungan dengan pembayaran uang yang diterima dari Kuasa Pengguna Anggaran Lembaga Penelitian dan Pengabdian kepada Masyarakat (LPPM) Universitas Negeri Semarang (UNNES) Kode Satker (677507) sebesar Rp. 100.000.000,00 (seratus juta Rupiah), berdasarkan Kontrak Penelitian:

Tanggal : 26 April 2021
Nomor : 14.26.4/UN37/PPK.3.1/2021
Pekerjaan : Penelitian Penelitian Kerjasama Dana DIPA UNNES Tahun 2021
STRUCTURAL HEALTH MONITORING OF MERAH PUTIH AMBON CABLE-STAYED BRIDGES SUBJECTED TO NEAR FAULT EARTHQUAKE
Nilai Kontrak : Rp. 100.000.000,00

Dengan ini menyatakan bahwa Saya bertanggungjawab penuh untuk menyelesaikan prestasi pekerjaan sebagaimana diatur dalam Kontrak Penelitian tersebut di atas.

Apabila sampai dengan masa penyelesaian pekerjaan sebagaimana diatur dalam Kontrak Penelitian tersebut di atas saya lalai / cidera janji / wanprestasi dan / atau terjadi pemutusan Kontrak Penelitian, saya bersedia untuk mengembalikan / menyetorkan Kembali uang ke kas BLU sebesar nilai sisa pekerjaan yang belum ada prestasinya.

Demikian surat pernyataan ini dibuat dengan sebenarnya.

Semarang, 27 April 2021

Mengetahui,
Ketua LPPM UNNES

Dr. Suwito Eko Pramono M. Pd.
NIP. 195809201985031003

Yang menyatakan
Ketua Pelaksana,

Dr RINI KUSUMAWARDANI S. T., M. T., M. Sc
NIP : 197809212005012001

FINAL REPORT
INTERNATIONAL RESEARCH COLLABORATION

RESEARCH TEAM:

STRUCTURAL HEALTH MONITORING OF MERAH PUTIH AMBON CABLE-STAYED BRIDGES SUBJECTED TO NEAR FAULT EARTHQUAKE

RESEARCH TEAM:

Dr. Rini Kusumawardani, MT	NIDN 00210978001
Dr. Nur Qudus, MT, IPM	NIDN 0030116906
Azzah Balqis Sabbah, MT.	NIDN 0317099301
Nur Cahyo Nugroho, SE	NIP 198101312006041004

STUDENTS:

Fadhila Rizqina Heriyanto	NIM 5111420075
Inas Salma Devianti	NIM 5111420072
Teguh Apriliyanto	NIM 5111418066

RESEARCH PARTNERS:

Prof. Dr. Nor Hayati Abdul Hamid	(Universiti Teknologi Mara, Malaysia)
Dr. Sakhiah Abdul Kudus	(Universiti Teknologi Mara, Malaysia)
Ir. Ts. Dr. Anizahyati Alisibramulisi	(Universiti Teknologi Mara, Malaysia)
Assoc. Prof, Dr. Rohana Hasan	(Universiti Teknologi Mara, Malaysia)

Daftar Isian Pelaksanaan Anggaran (DIPA) Universitas Negeri Semarang (UNNES)
Nomor DIPA SP DIPA-023.17.2.677507/2021, tanggal 23 November 2020 sesuai dengan
Surat Perjanjian Penugasan Pelaksanaan Penelitian Dana DIPA UNNES Tahun 2020
Nomor : 102.23.4/UN37/PPK.3.1/2020, tanggal 18 April 2021

FACULTY OF ENGINEERING
UNIVERSITAS NEGERI SEMARANG
NOVEMBER, 2021

HALAMAN PENGESAHAN PENELITIAN

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Most of the existing civil infrastructures such as bridges, buildings, pipeline and offshore structure area are the valuable national assets. Bridge structure is one of the important civil engineering assets designed to sustain continuous large number of repeated and cyclic loadings under vehicular traffic, wave, wind and earthquake load.

Indonesia and Malaysia was considered to be safe against an earthquake hazard. However, based on new seismic zone map, Indonesia is categorized as a country with high risk of earthquake disaster and west Malaysia is categorized as low seismic region and east Malaysia is classified as moderate seismic region. Most of the bridges in Indonesia and Malaysia were designed using British Standard (BS) where there is no provision for earthquake load at all. Thus, these bridges are vulnerable to ground motion and require continuous monitoring in order to ensure safety to the users. Furthermore, the effect of long-distant earthquake fault lines from nearby country will affect the seismic performance of Malaysia bridges. Therefore, the present study will investigate the existing bridge at Indonesia near fault lines which can also be implemented to improve the seismic resistance of bridge in Indonesia and Malaysia. The near fault earthquake induced large amplitude due to seismic wave propagation in granular soil which affects the structural performance of the bridges. Bridge is very important assets in Indonesia because it connects people from one island to another island.

In order to verify the data obtained from field study, the 3D Finite Element Model of the bridge will be conducted. The cable-stayed bridge with pylon will be modelled and the modal parameter of the bridge model will be extracted from modal analysis. The results obtained from the field test will be validated with the result obtained from the FE model. Model updating is fully utilized to make sure that the experimental results will be similar with the modelling results. Validation process will be conducted based on trial and error by changing the physical and dynamic properties of the materials used for the construction of Merah Putih Ambon cable-stayed bridge. In order to simulate the condition of cable-stayed bridge due to near fault earthquake records, a few data real earthquake data from the site are required. The bridge model will be run under different levels of earthquake excitations to determine their mode shapes, frequencies, damping, displacement, based shear and moments The prediction of structural damages and damage states can be predicted based on site measured displacement which can be converted into percentage drift. Furthermore, the predicted damages also can be based on the visual observation and inspection at sites.

To achieve the expected research results and the expected outputs and outcomes in this study are paper submit in international journal, accepted in international conference,Implementation of Agreement.

TKT : 3

Kata kunci: shear strain, cable-stayed bridge, earthquake

CHAPTER I
INTRODUCTION

Most of the existing civil infrastructures such as bridges, buildings, pipeline and offshore structure area are the valuable national assets. Bridge structure is one of the important civil engineering assets designed to sustain continuous large number of repeated and cyclic loadings under vehicular traffic, wave, wind and earthquake load. However, Jabatan Kerja Raya (2007) reported that more than 400 bridges in Malaysia are categorized as critical condition due to deterioration. In addition, 15 million ringgit was spent for bridge repair and maintenance works in the same year. Different type of bridge deterioration mechanisms has led to major defects. The deterioration problem becomes more serious with the issues of lack maintenance, improper and ineffective maintenance technique that currently applied to the bridges.

Previously, Indonesia and Malaysia was considered to be safe against an earthquake hazard. However, based on new seismic zone map, Indonesia is considered as a country with high seismic risk country and west Malaysia is categorized as low seismic region and east Malaysia is classified as moderate seismic region. Most of the bridges in Indonesia and Malaysia were designed where there is no provision for earthquake load at all. Thus, these bridges are vulnerable to ground motion and require continuous monitoring in order to ensure safety to the users. Furthermore, the effect of long-distant earthquake fault lines from nearby country will affect the seismic performance of Malaysia bridges. Therefore, the present study will investigate the existing bridge at Indonesia near fault lines which can also be implemented to improve the seismic resistance of bridge in Malaysia. The seismic response of cable-stayed bridges have attracted the interest of researchers since the early 80's [1]. Important damages have been reported in several cable-stayed bridges after strong earthquakes in the 80's and 90's. This is the case of the Shipsaw Bridge (Canada, 183 m span length), damaged at the connection between the deck and the tower during the 1998 Saguenay earthquake, with moment magnitude = 6.0 [2]. The damage of the Higashi-Kobe Bridge piers (Japan, 485 m span) (Bruneau et al, 1995). Reported the severe spelling and cracking at the tower of the Chi-Lu Bridge (Taiwan, 120 m span) after the great Chi-Chi earthquake, 1999, magnitude = 7.3 [3].

The technique of structural health monitoring (SHM) has been widely used especially in developed countries such as United States of America, United Kingdom, Europe and Japan.

Structural health monitoring (SHM) is expected to provide an economical and efficient bridge inspection for short term and long-term duration. A structural health monitoring (SHM) system that is used for surveillance, evaluation and assessment of the condition of existing long-span bridges has been widely developed, and the recently-developed long-term SHM system is one of cutting-edge systems for monitoring the serviceability, safety, and sustainability of long-span bridges [4].

Even though SHM has been applied to damage detection but assessment of the current structural performance is still under investigations and discussions. A SHM system has been implemented in the Lupu bridge which is a steel half-trough tied arch bridge and the second longest arch bridge in the world. The temperature, strain, acceleration,and wind effect of the bridge were monitored by the system [5]. A large scale SHM application for the Sydney Harbour Bridge which is an arch bridge with a main span of 503 m [6]. The performance and structural damages of a subset of 800 jack arches under the traffic lane 7 were analyzed based on the data acquired from the SHM system [7]. A part from the above SHM systems, many other SHM systems have been installed in long-span bridge. Typical examples include the Sutong bridge (1088 m, a cable-stayed bridge in China) [8]- [9], the Tsingma bridge (1337 m, a suspension bridge in Hong Kong) [10], the Tatara Bridge (890 m, a cable-stayed bridge in Japan), the Akashi Kaikyo Bridge (1991 m, a suspension bridge in Japan) [11], the Great Belt East Bridge (1624 m, a suspension bridge in Denmark) [12], the Normandie Bridge (856 m, a cable-stayed bridge in France) [2].

Many researches have made the efforts to the parameter identification, damage detection, model updating, safety evaluation and sustainability assessment of long-span bridges by using the data observed from SHM systems. Identification modal parameters of civil structures including arch structures based on the data observed from SHM systems by using modal-based damage detection algorithms [13]-[16]. In this study, SHM technique will be used to evaluate the condition of Merah Putih Ambon cable-stayed bridge for the duration of two years. Finite Element Modelling will be fully utilized before and after inspection so that the real structural behaviour of this bridge can be determined.

After that, the seismic behaviour of the cable-stayed bridge can be predicted under future ground motions. In addition, this study also aims to examine the effect of near fault earthquakes excitations of a cable-stayed bridge which has a significant influence on its dynamic properties such as mode shapes, frequencies, displacements, moments, forces and others. In analysis the effect of

earthquake, both static and the dynamic responses of a cable-stayed bridge may present significant material or geometric nonlinearities [17]-[18]

Objectives :

1. The main objective of this study is to identify status of soundness of monitored structure at earliest possible stage.
2. The implementation of new approach for bridge health monitoring by our local authority may reduce overall maintenance cost and repair work due to capability of early detection of damages.
3. In addition, the new guideline on damage assessment technique could benefited by allowing for better future maintenance and repair work plan.

CHAPTER II
LITERATURE REVIEW

The continuous development in the technology is indispensable prerequisite to ensure and maintain serviceability, durability and the safety of the bridge structure. With regards to these issues, an urgent need for effective bridge damage assessment is necessary.

Structural Health Monitoring (SHM) had been actively implemented by bridge owner in European countries as damage detection strategy and to obtain the current condition of the bridge. However, SHM has not yet been widespread in Malaysia due to lack of support from codes, standards, guidelines and authorities. With the availability of monitoring data from SHM, future bridge performance can be predicted. Hence, the maintenance of the bridges can be planned properly and monitor periodically. The maintenance strategy should be aimed in maximizing the possibility of successful future performance at minimum costs.

Figure 1. "Merah Putih Ambon" cable-stayed bridge.

In general, SHM system comprises of detection, monitoring, and assessment of any events that may affect the health state of the structure globally. The fundamental Non Destructive Test (NDT) method is the visual inspection method and measurement which did not destroy the structures. Visual observation and testing is the most reliable and significant NDT method. This

method provides valuable information to the well-trained eye [19]. In order to have better results in this inspection, a magnifying glass is often used to find the cracks on the surfaces of the structures.

Most of the literatures had utilized the changes in measured vibration response for damage assessment and identification because the presence of structural damage leads to the alteration in vibration characteristics in terms of natural frequency, mode shapes, and modal damping [20]-[21]. SHM is a technique used to determine the damage by observation of the changes from its vibration modes [22]-[24].

Various methods have been proposed for evaluating the soundness of bridges. Visual inspection is one of the most popular approaches to assess integrity of the cable-stayed bridge. Another approach is known as vibration-based structural health monitoring (SHM). In general, deteriorations and damages in a structure appear as changes in vibration characteristics such as natural frequency, damping ratio, and mode shape. However, it is not clear how failure process of actual PC girder bridges changes the vibration characteristics of the PC bridge.

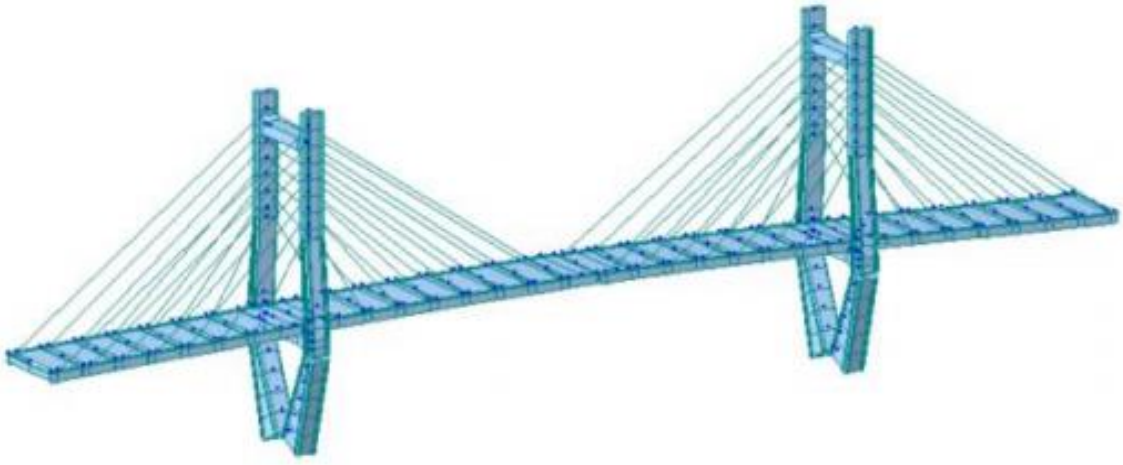


Figure 2. finite element method for evaluating inspection

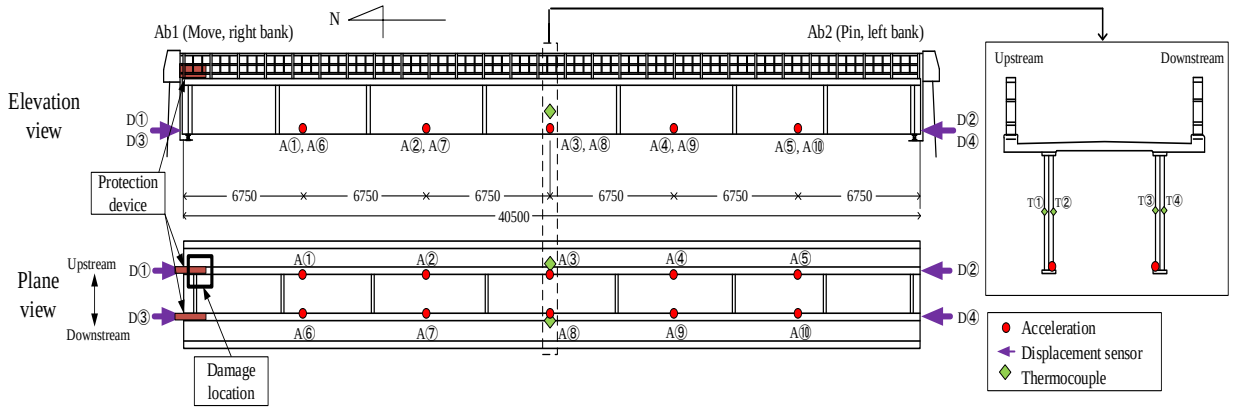


Figure 3. Plan for sensor placement on the monitored bridge

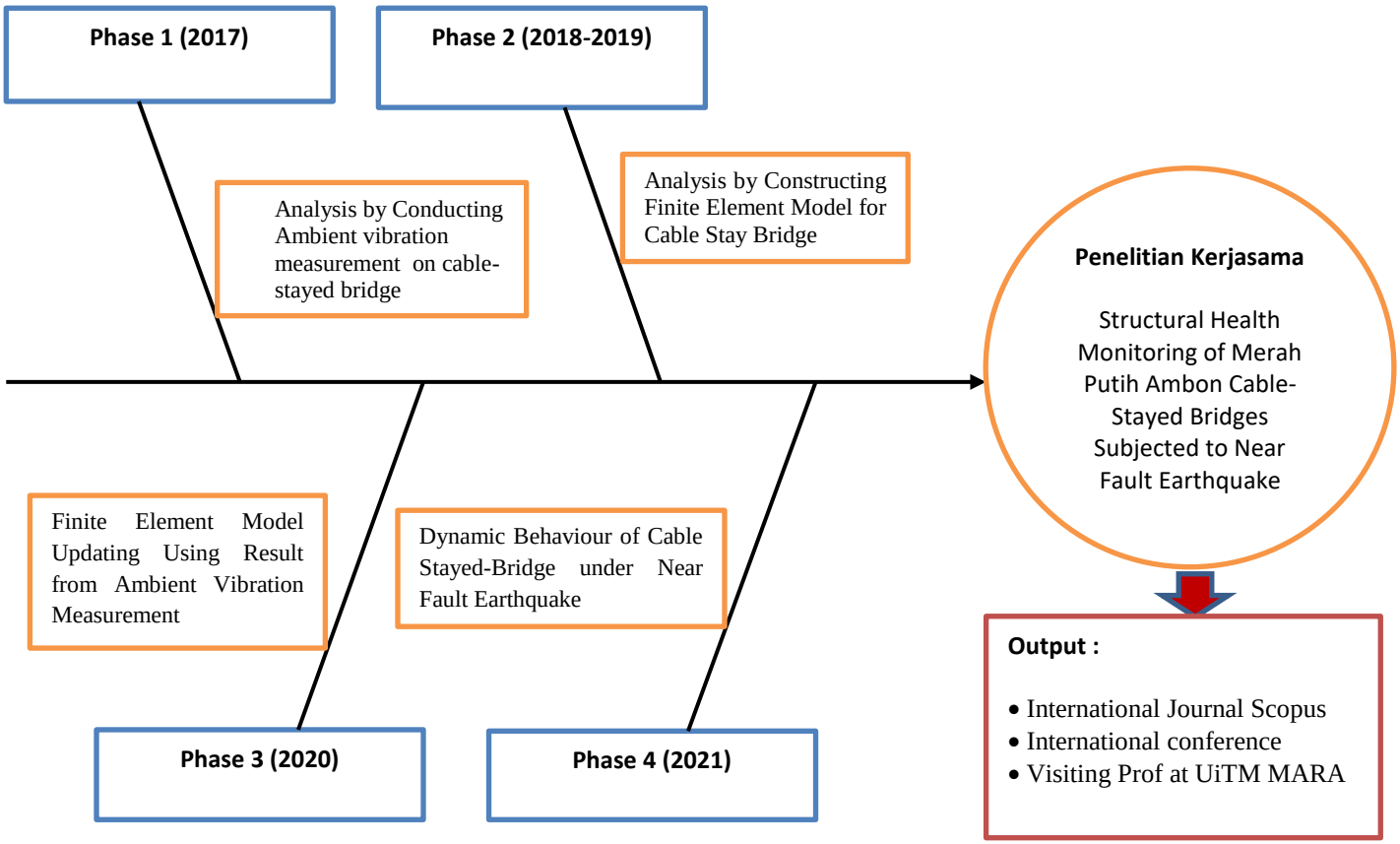


Figure 4. Fishbone diagram research plan

CHAPTER III
AIMS OF RESEARCH

3.1. Aims of research

The dangers of earthquakes threaten the property and lives of the Indonesian population, but alsa structure and infrastructure life-time. The mitigation efforts to reduce losses are felt to be lacking. The development of a disaster mitigation system in areas prone to earthquakes and liquefaction is needed to reduce the level of losses and casualties. This research tries to develop subgrade improvement efforts which are one of the occurrences of building collapse when an earthquake occurs. In addition, it also develops a mitigation system for earthquake disasters and liquefaction in earthquake-prone areas. Structure Health Monitoring Systems to reduce the risk of loss due to earthquake disasters will be developed in stages by applying several main parameters to evaluated to the structure life time.

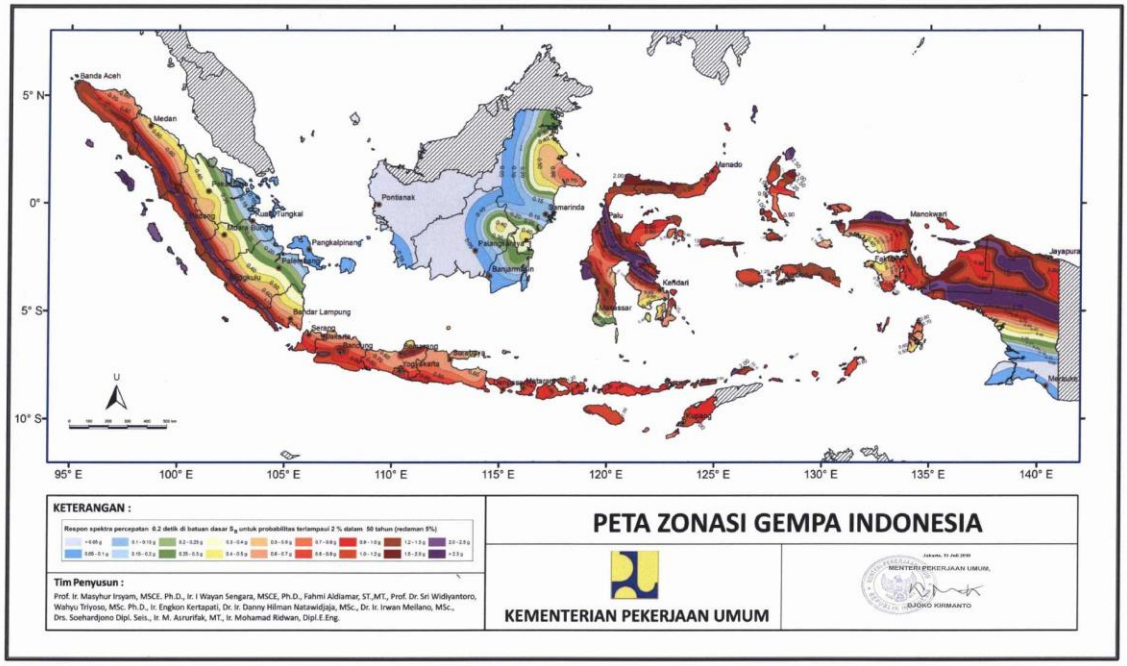
3.2. Benefits of research

Some of the advantages and benefits that will be obtained if research on earthquakes and secondary disasters of liquefaction can be described as follows. For the development of the nation and state, this research provides guidance for the government in implementing spatial and regional governance. The construction of structures and infrastructure in areas prone to earthquakes and liquefaction that support economic growth is planned in detail and accurately, so as to reduce both mental and material losses if an earthquake or liquefaction occurs in the area. A careful planning of structures and infrastructure with attention to spatial and regional governance in areas prone to earthquakes and liquefaction will support government programs in implementing sustainable development

CHAPTER IV
METHODS OF RESEARCH

4.1. Study Area

The target bridge is “Merah Putih Ambon” cable-stayed bridge located in Ambon city, Maluku, Sulawesi, Indonesia. This bridge is connecting Rumah Village in Sirimau district with Hative Kecil in Teluk Ambon district. The main bridge is cable stayed bridge, with span between pylons measures 150 meters and two 75m side spans. The total length of the bridge is 1140m. The main span of the bridge is the target of the experiment. The bridge is considered new as it operates less than 10 years since its construction. The interesting part of this bridge is it was located in tectonic regions which are prone to earthquake excitations.



4.2. Methods of research

There are various established methods used in experimental testing to conduct vibration measurement. The common method used is the attachment of contact sensor for instance strain gauge and accelerometer to the structure (Doebling et al., 1996; Farrar et al., 1997) as indicated from **Figure 5** to **Figure 8**. The placement of the sensor on the monitored bridge will not cause any permanent damage. Accelerometer has shown a promising instrument providing precise measurement. The accurate vibration measurement is useful to lead to increase in the accuracy damage assessment in the monitored structure.

Figure 5. Plan for sensor placement on the monitored bridge

Figure 6. Placement of conventional strain gage on the flange of diagonal frame.

Figure 7. Deflection measurement from the ground

Figure 8. Placement of accelerometer on the cross beam of the monitored bridge.

The bridge health monitoring conducted gives benefit to the owner which provide information damage of the bridge. Additionally, the data on damages level obtained can be used by local authority to improve technique for the maintenance of existing bridge and may reduce overall maintenance cost and repair work due to capability of early detection of damages from Bridge Health Monitoring conducted at site.

The vibration measurement using high-speed camera is proposed to simplified the vibration monitoring. The high-speed camera was chosen because of the higher resolution which sufficient to capture the spatial data on the region monitored. The high framing rate of high-speed camera is able to capture motion of structure under excitation by its fundamental frequency. The arrangement represents the two-dimensional (2D) camera setup which allow the in-plane deformation to be measured. The high-speed camera data was synchronized with the measurement by strain gauge and accelerometer. Before proceeding to the testing, the calibration of camera system is needed. The planar calibration method is among the commonly used methods which comprise of intrinsic and extrinsic parameters of the camera simultaneously [12]. The calibration also allowed the transformation of image coordinate into geometric coordinate and maintain the data accuracy.

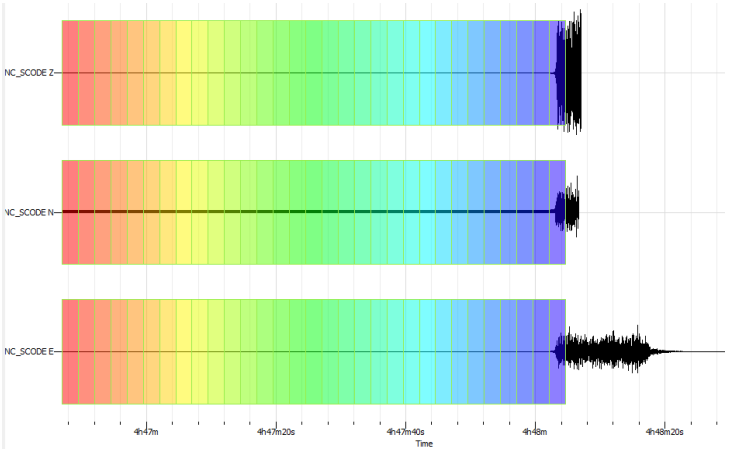
CHAPTER V
RESEARCH PROGRESS OUTPUT

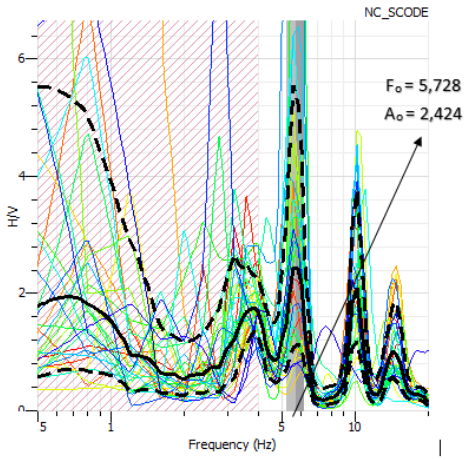
5.1 Site Investigation Report

Based on the research results, the data is processed using geopsy software to get the natural frequency(f_o) and amplitude (A_o) when the bridge structure is loaded from the load of the train crossing the bridge structure. The data obtained is the result of seismic monitoring sensor recording when positioned in one third of the bridge structure span and in the middle of the bridge structure span. Based on data processing using geopsy software, natural frequency (fo) and amplitude (Ao) data are obtained as follows:

a. Point 1

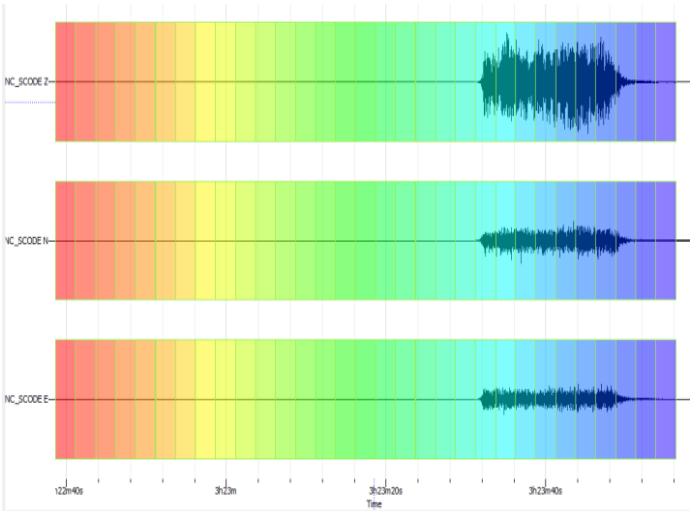
The trafic when crossing the bridge structure with a speed of 75.64 km / hour has a natural frequency (fo) of 5.728Hz and an amplitude of 2.424

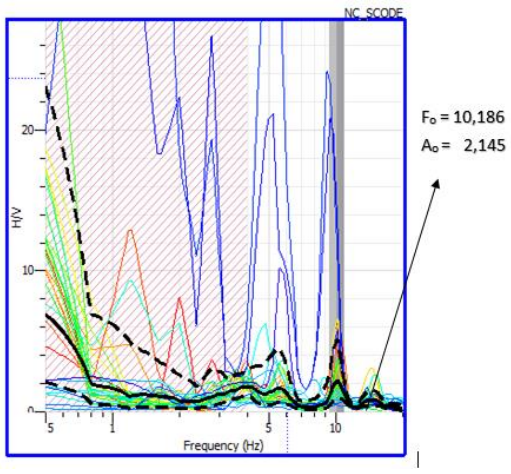




b. Point 2

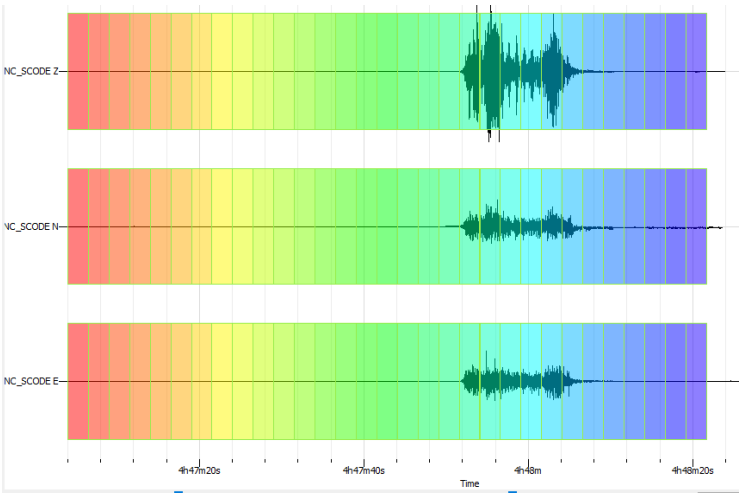
The trafic when crossing the bridge structure with a speed of 72.42 km / hour has a natural frequency (fo) of 10,186 Hz and an amplitude of 2,145

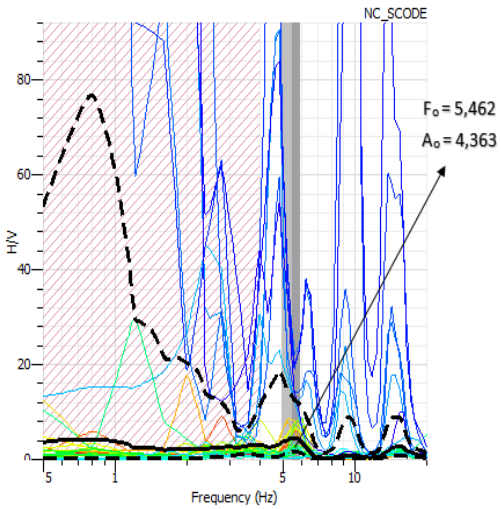




c. Point 3

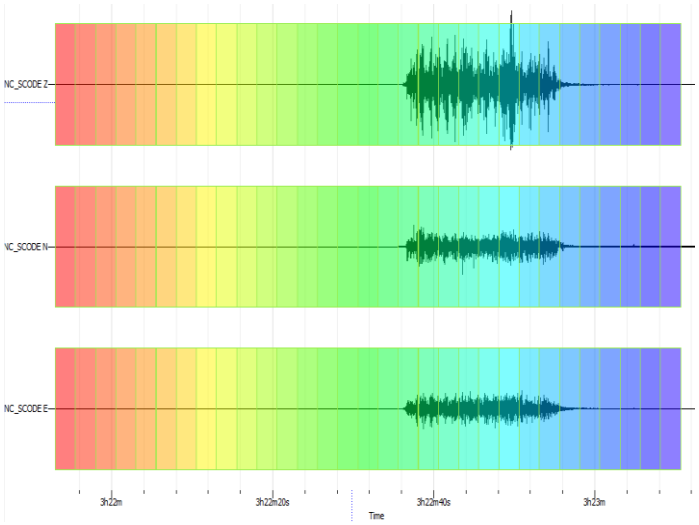
The trafic when crossing the bridge structure with a speed of 78,85 km / hour has a natural frequency (fo) of 5,462 Hz and an amplitude of 4,363

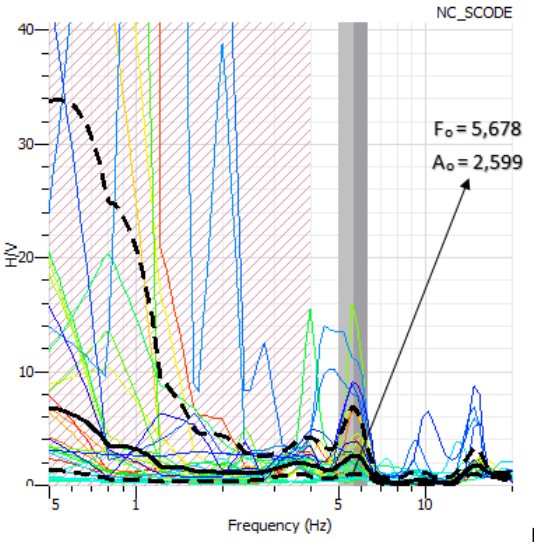




d. Point 4

The trafic when crossing the bridge structure with a speed of 74,03 km / hour has a natural frequency (fo) of 5,678Hz and an amplitude of 2,599.





5.2 Research output

1. Article presented in International Conference

Conference name : 2021 International Civil Engineering and Architecture Conference (CEAC 2021)

Date : March 11-14 March, 2021

2. Article Journal LNCE (Scopus Index) --- Accepted

Publishing Agreement

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This Publishing Agreement (this "**Agreement**") has been approved by and entered into between:

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4. Article draft

Vibration Analysis on a Railway Bridge Structure

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Abstract. The railway bridge would be vibrating when a series of train passed on it. The movement a train triggers a noise to the bridge structure which is generated by the combination of small-scales undulation between wheel of train, railway and bridge railway contact surfaces. Nowadays, railway researches focused on dynamic behaviour of railway track when the train passed on it. This study discusses the dynamic behaviour of railway bridges vibrations caused by train traffic load in terms of three axis direction (x, y and z direction). A field investigation was conducted by applied a series of accelerometers to find out the value of frequency natural and amplitude. The tools are placed on the beam at a half span and at a third span. The results were compared between passengers train and carriage train. During unloaded condition, the range of frequency natural is 0.78 Hz to 3.73 Hz and amplitude is in between 1.82 to 1.89. When the train passes by, the range of frequency natural is in between 1.03 Hz; to 5.77Hz and amplitude 1.70. to 4

Keywords: vibration analysis, railway bridge, HVSR

1. Introduction

The ambient noise of the earth is generated by many independent sources that affect the overall frequency band of the natural background wave field. Frequencies below 1 Hz are largely generated by oceanic and large-scale meteorological events. At frequencies above 1 Hz, the noise wave field in urban settings is dominated by cultural sources, particularly traffic, whereas in remote sites wind generated noise is the predominant source. Cultural noise typically exhibits daily and weekly cyclical variations linked to human activities [1].

The measurement of ambient noise in the frequency band below 1 Hz can help in our understanding of the interaction between the solid earth, oceans and atmosphere. Ambient noise in the 1 – 10 Hz frequency range (commonly known as microtremor) can provide a low-cost and noninvasive exploration solution in urban sites where geotechnical information is often difficult to obtain [2]. As a results microtremor measurements have been used in many studies to determine fundamental resonant frequencies, shear-wave velocities and thicknesses of unconsolidated shallow sediments. These data can be used to predict local amplification of ground motion during earthquake and for the preparation of seismic microzonation maps. Such information is crucial for seismic hazard assessment [3], [4]. Predictions based on microtremor data have been verified using other seismic techniques. For example, patterns of ground motion amplification observed during earthquake are comparable to amplification patterns modelled from microtremor data [5], [6], [7], [8].

The responses of the railway bridge when the train passed on it is one of crucial aspect in the point of view bridge structure railway capacity support the dynamic loading. Lorieux [9] revealed the train speed induced the dynamic behavior of bridge particularly the amplitude and frequency. They are having a positive correlation; the increasing of train speed will be increase the amplitude of dynamic behavior of a railway bridge and rails. Rigid railway bridge and tracks have non-elastic behaviour, therefore when vibrations occur, the ballast particle displacement is often irreversible and the accumulation of these minor displacements results in settlements and degradation of the track itself. The complexity of the structural response of train load and speed based on the interaction of parts of the track-railway bridge system which is consist of rails, sleepers, ballast, girders and foundations. Each elements of the bridge has its own behavior with different characteristics. Due to the non-linear differences of each element, it is very difficult to

predict the distribution of stresses and vibrations of each element. The aims of this article to revealed the dynamics behavior of railway bridge by using microtremor methods to understand the dynamic properties of railway bridge

2. Materials and Methods

In this work is using the HSVR (Horizontal to Vertical Spectral Ratio) which could be used as indicator the subsurface structure which shows the relationship between the Fourier spectrum ratios of the horizontal component microtemor signal to its vertical component. This method utilized three direction components which consist of two horizontal components and one vertical component. The results of the HSVR method are natural frequency and amplification [10] could be used to determine the maximum value of vibration acceleration, amplitude and natural frequency.

The type of railway bridges is closed frame bridge which could be seen in Figure 1. A railway bridge in Semarang city is chosen as appropriate model for this study. This railway bridge is fully composed by steel material and constructed over the river which cross cut the east of Semarang city, Central Java province, Indonesia. The measurements length and width of railway bridge during the field investigation are 42 meters and 5.13 meters respectively and the support is identified as roll at both side.

5. Visiting Professor

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Cawangan Pulau Pinang
Kampus Permatang Pauh

Our Reference : 100-UiTMPP(HEA.OIA.30/2)
Date : 30th September 2020

Assoc. Prof. Dr. Rini Kusumawardani
Universitas Negeri Semarang
Gd, E11 Lt. 1 Kampus Unnes Sekaran
Gunungpati, Semarang 50229
Indonesia

Dear Assoc. Prof. Dr.,

APPOINTMENT AS VISITING PROFESSOR AT THE FACULTY OF CIVIL ENGINEERING, UNIVERSITI TEKNOLOGI MARA, CAWANGAN PULAU PINANG, MALAYSIA

I am pleased to inform you that Universiti Teknologi MARA, Cawangan Pulau Pinang (UiTMCPP) has appointed you as a Visiting Professor at the Faculty of Civil Engineering for a period of 1 semester with effect from 1st October 2020 until 31st January 2021.

We believe that your vast experience and expertise in education would contribute significantly towards enhancing the quality of the program at the faculty. We hope you will be able to share your experience and expertise with our students and lecturers during this appointment. In addition, your name will also be listed on the UiTMCPP website as one of our visiting professors.

We hope you will accept this appointment. Please feel free to contact our academic affairs office should you require any further information.

Thank you.

Yours sincerely,

PROFESSOR Ts. DR. SALMIAH KASOLANG
Rector

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6. IA of Research partner

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UNIVERSITI TEKNOLOGI MARA

Pejabat
Timbalan Naib Canselor
(Penyelidikan dan Inovasi)

Surat Kami : 600-RMC/SRP-UNNES/5/3 (007/2020)
Tarikh : 1 November 2020

Pn. Ayu Rohaidah Binti Ghazali
Ketua Projek
Uitm Kampus Puncak Alam
Universiti Tekonologi MARA
Cawangan Selangor
Kampus Puncak Alam
42300 Bandar Puncak Alam
SELANGOR

Puan,

PENAWARAN GERAN PENYELIDIKAN *STRATEGIC RESEARCH PARTNERSHIP (SRP)* - UNNES

Tajuk Projek	:	*The Development of Sustainable Community Based Tourism in Tuba Island, Malaysia*
No. Fail RMC	:	600-RMC/SRP-UNNES/5/3 (007/2020)
Tempoh		1 November 2020 – 31 Oktober 2022
Peruntukan Diluluskan	:	RM 20,000.00
Perkhidmatan Penyelidikan	:	RM 1,000.00
Peruntukan Pengoperasian	:	RM 19,000.00
Ketua Projek	:	Pn. Ayu Rohaidah Binti Ghazali
Ahli Projek	:	Prof. Madya Dr. Norol Hamiza Binti Zamzuri Dr. Mohd Hafiz Bin Mohd Hanafiah Dr. Atika Wijaya Dr. Suwito Eko Pramono

Dengan segala hormatnya perkara di atas adalah dirujuk.

2. Sukacita dimaklumkan Pejabat Timbalan Naib Canselor (Penyelidikan & Inovasi) telah meluluskan permohonan pendaftaran penyelidikan puan untuk dibiayai di bawah geran penyelidikan *Strategic Research Partnership (SRP)* – UNNES.

3. Bagi pihak universiti, Pejabat Timbalan Naib Canselor (Penyelidikan & Inovasi) mengucapkan tahniah kerana memperolehi geran ini dan berharap pihak puan berjaya menyiapkan projek penyelidikan dengan cemerlang. Untuk makluman puan, pelaksanaan setiap projek penyelidikan perlu mengikut jadual perancangan dan mematuhi hasilan penyelidikan seperti yang telah ditetapkan. Segala perolehan dan perbelanjaan perlu mematuhi tatacara kewangan dan peraturan universiti.

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7. LoO of Research

MINISTRY OF EDUCATION AND CULTURE
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10th August 2020

LETTER OFFER
B/2687/UN37.3.1/PG/2020

With refer to the above.

On behalf of LPPM, Universitas Negeri Semarang (UNNES) is very glad to inform you that your application for Grant "International Research Collaboration" as group member is successful with the amount of Rp. 100.000.000,-.

Group Leader : Dr. Rini Kusumawardani, M.T. (UNNES)

RESEARCH PARTNERS:
Team Members : 1. Dr. Nur Qudus, M.T. (UNNES)
2. Azzah Balqis Sabbah, MT. (UNNES)
3. Prof. Dr. Nor Hayati Abdul Hamid (UiTM)
4. Dr. Sakhiah Abdul Kudus (UiTM)
5. Ir. Ts. Dr. Anizahyati Alisibramulisi (UiTM)
6. Assoc. Prof, Dr. Rohana Hasan (UiTM)

Title : Structural Health Monitoring of Merah Putih Ambon Cable-Stayed Bridges Subjected to Near Fault Earthquake

Grant Amount : Rp. 100.000.000,-.

Date start 28th April 2020, Date end 13th November 2020

Therefore, your cooperation for this project collaboration is highly appreciated. Please contact the Group Leader: Dr. Rini Kusumawardani, M.T. (rini.kusumawardani@mail.unnes.ac.id) for further discussion.

Your attention is highly appreciated.

Sincerely Yours,

Dr. Suwito Eko Pramono, M.Pd.
Head of Reseach and Community Service Institute of UNNES

CHAPTER VI
CONCLUCION AND RECOMMENDATION

5.1. Conclusion

The conclusions from the analysis of potential liquefaction due to earthquakes in several regions in Indonesia in this thesis are as follows:

1. After calculating the potential for liquefaction using the semi-empiric method in several regions in Indonesia, most of the land depths in Aceh are indicated to be experiencing liquefaction. All soil depths indicate liquefaction in the Padang area. Most of the soil depths in Bengkulu are indicated to have liquefaction and only a few soil depths are not indicated. Some of the soil depths in Yogyakarta indicate liquefaction. In the region of Ende District, almost all soil depths are indicated to have experienced liquefaction.
2. The semi-empirical method is used as a practical method of analyzing the potential for early stage liquefaction to determine the potential or not of soil in the study area. Meanwhile, to find out in more detail the depth of the soil indicated liquefaction, numerical methods are used with the help of cyclic1D software.
3. Analysis of the potential for liquefaction using numerical methods for the coastal area of Pandansimo, Bantul, Yogyakarta. There are indications of potential liquefaction at a depth of 13 and 14 meters for the BH-2 point. The point of BH-3 has the potential for liquefaction at a depth of 8 - 15 meters. Meanwhile, the point BH-4 has the potential for liquefaction at a depth of 16 and 17 meters.
4. Estimated land subsidence (settlement) due to liquefaction for the Aceh region ranges from 25 cm - 55 cm, the Padang area ranges from 20 cm - 75 cm, the Bengkulu area ranges from 50 cm - 120 cm, the Yogyakarta area ranges from 1 cm - 30 cm, and the Ende region of soil soil ranges from 10 cm - 80 cm.
5. The greater the earthquake magnitude that occurs in an area, the greater the energy released from the epicenter (hypocenter) which can cause damage, including damage to the soil structure, one of which is liquefaction.

5.2. Suggestion

1. Soil data used in the calculation of the analysis of liquefaction potential in several regions in Indonesia should use primary data from soil test results in the field and in the laboratory, so that the calculation results are more accurate and valid.

2. The difficulty of accessing earthquake data, which in this case is the earthquake accelerograph data based on the time function as a vibration input in the Cyclic1D software, hinders the running of the research in this thesis. Therefore, the Agencies and Agencies concerned should provide full support in order to increase the development of science, such as research in this thesis. So that in the future if a large earthquake occurs in the territory of Indonesia, preventive measures can be taken to minimize the impact of the liquefaction phenomenon.

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