TECHNISCHE HOCHSCHULE
OSTWESTFALEN-LIPPE
UNIVERSITY OF
APPLIED SCIENCES
AND ARTS

Modulhandbuch

Master Integrated Design

Module Title	Facade Design and Construction			
Module Number	**MID 1000**			
Module Responsibility	Prof. Dipl.-Ing. Daniel Arztmann			
Lecturer	Prof. Dipl.-Ing. Daniel Arztmann, Prof. Dr.-Ing. Winfried Heusler, wiss. Mitarbeiter, Lehrbeauftragte, Industry Experts, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module FD	x	Compulsory Module	
Semester	1			
Forms of Teaching	Lecture, seminar, workshop			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	1	Other	4
Workload (h)	Lecture	15	Laboratory	
	Seminar	30	Workshop	30
	Excursion		Work Experience	
	Self-Study	240	Exam Preparation	45
Workload total (h)	360			
Credits	12			
Prerequisites	None			
Focus on the Sustainability Goals (17 UN SGDs)	▪ Good Health and Well-Being Building envelopes contribute to urban health and well-being as well as to a comfortable and healthy interior living on a large scale. ▪ Affordable and Clean Energy A well and careful designed, manufactured and installed façade has a huge impact on the operational and embodied energy consumption of a building. With the inclusion of photovoltaics and wind power it can be used for renewable energy production. ▪ Industry, Innovation and Infrastructure Considering local conditions and cultural characteristics in façade product and building design help to build a resilient infrastructure. Principles like design from / for recycling, the development of refurbishment and reuse strategies and the implementation of renewable energy concepts in the design of new products foster sustainable industrialization and innovation. ▪ Climate Action The reduction of operational and embodied energy consumption leads to an improved Co² foodprint of a building what helps to mitigate climate change. Furthermore, resilient building envelopes are designed to withstand changing			

	weather conditions and the direct impacts of the climate change like hurricanes, strong rains, hail, high temperatures.
Goal of study and Competences	▪ preparation for facade consultant´s or engineer's work: supporting the architectural concept making and decision finding, communication of relevant content (construction, structure materials, building physics, building services) related to the architectural concept and its relation to inner and outer space. ▪ gain basic knowledge of developing facade principles while considering different conditions governing location depending on the given task ▪ discuss, evaluate and support the development of different solutions for challenging facade constructions in an overall design approach for a case-study building in different climatic regions. ▪ applying the knowledge in concept and construction drawings for the given project (scale 1:20 to 1:1) ▪ presentation and discussion of the results in the plenum
Contents of Study	▪ lectures on specific existing facade principles and examples, typology of windows and facades and their construction principles, manufacturing and process of production line, assembly on-site (on-site tolerances, just in time handling, problems according to other trades, assembling etc.), ▪ analyzing specific facade details through hands-on assembly of a stick construction mock-up ▪ introduction and discussion of a representative case-study for the main project design, ▪ methods of presentation, structuring and organizing of content to prepare an adequate project description
Forms of Exams	Elaboration, presentation, oral examination, written examination
Literature	▪ Scripts, company's records and documents at Ilias ▪ Ching, Francis D.K. (2020). Building Construction Illustrated, New Jersey: Wiley Verlag ▪ Compagno, Andrea (2002). Intelligent Glass Facades. Berlin: Birkhäuser ▪ Cremers Jan et al. (2016). Building Openings Construction Manual. Munich. DETAIL Verlag ▪ Hausladen, Gerhard et al. (2011). Building to Suit the Climate – A Handbook. Basel: Birkhäuser Verlag. ▪ Herzog, Thomas et al. (2021). Facade Construction Manual. Munich: DETAIL Verlag. ▪ Hindrichs, Dirk U. (2007). Plusminus 20°/40° latitude, Sustainable Building Design in Tropical and Subtropical regions, Stuttgart: Edition Axel Menges ▪ Knaack, Ulrich et al. (2012). Principles of Construction - Facades. Basel: Birkhäuser Verlag. ▪ Knaack, Ulrich et al. (2022). JFDE - Journal of Facade Design and Engineering, Online Ressource: https://www.jfde.eu/index.php/jfde/index ▪ Köhler, Manfred (2012), Handbuch Bauwerksbegrünung, Köln: Rudolg Müller Verlag ▪ Oesterle, Eberhard et al. (2001). Double-Skin Facades. Prestel Verlag

	▪ Patterson, Mic (2011). Structural Glass Facades and Enclosures. Wiley. ▪ Pfoser, Nicole et al. (2014), Gebäude, Begrünung, Energie, Bonn: FLL ▪ Pottgiesser, Uta (2004). Fassadenschichtungen Glas. Berlin: Bauwerk Verlag ▪ Rice, Peter et al. (1995). Transparente Architektur – Glasfassaden mit Structural Glazing, Basel : Birkhäuser Verlag ▪ Schröpfer, Thomas et al. (2011). Material Design – Informing Architecture by Materiality, Basel: Birkhäuser Verlag

Module Title	Computational Architectural Design			
Module Number	**MID 1010**			
Module Responsibility	Prof. Hans Sachs			
Lecturer	Prof. Hans Sachs, Prof. Markus Schein, Lehrbeauftragte, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module	x	Compulsory Module	
Semester	1			
Forms of Teaching	Design Studio with lectures, seminar and desk crits, literature on digital media (via ILIAS)			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	1	Other	5
Workload (h)	Lecture	15	Laboratory	
	Seminar	30	Workshop	45
	Excursion		Work Experience	
	Self-Study	240	Exam Preparation	30
Workload total (h)	360			
Credits	12			
Prerequisites	None			
Focus on the Sustainability Goals (17 UN SGDs)	The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. The Professorship of CAAD respectively to its activities in the Master of Integrated Design and the Master of Integrated Architectural Design sets a strong focus on a sustainable digital transformation in the building sector and especially integrates the following Sustainable Development Goals of the UN into its curriculum: ▪ Good Health and Well-Being In the built environment materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and well beeing. Here digital technologies provide a vast field of potential for the support of planning, building and controlling processes with accurate and widely data-based analysis, calculation, simulation and generation of architectural space. ▪ Affordable and Clean Energy A large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to have less negative impact on the world's climate. Thus planning and building must develop and integrate new energy and resource			

	efficient technologies, material efficiency and consciousness. As well it must support and protect natural ecosystems. Digital tools and methods can enable, trigger, integrate, calculate and support concepts with a focus on energy efficiency in architecture. ▪ Industry, Innovation and Infrastructure Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of the digital transformation in building construction needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ Sustainable Cities and Communities Large Cities will be the key drivers of developments for Intelligently and socially digitized, sustainable habitats in the future as they are the main polluters, energy consumers and hot spots for social inequality today. New concepts and rule-sets for a cohabitation of vegetation, humans, animals and robots need to be mindfully explored, tested and applied. ▪ Responsible Consumption and Production An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. In this intertwined system of a future digital production, use and consumption in the built environment new concepts for (digital) process chains need to be explored and developed. ▪ Climate Action Digital Tools (Software) and related Methods represent a comprehensive source for optimization, monitoring, documentation and control of architectural spaces as well as building components. When integrated and applied well, they have a large potential to reduce, reflect, detect and adjust climate-damaging effects in the building industry. They can have a positive impact through digital planning & fabrication, house automation (smart home) and digitized re-use and recycling processes. ▪ Partnership for the Goals The Digitalization of research networks enables global, faster and further reaching communication, documentation and (knowledge) exchange on the processes and goals mentioned above. The focus of the University lies on the development of more exchange in study programs, students, teaching staff, facilities and research activities, especially on initiatives on more sustainability.
Goal of study and Competences	▪ Preparation for computational designer´s or consultant's work: support the concept making and decision finding of the architectural design, communication of relevant content (construction, structure, materials, building physics, building services) related to the architectural and computer driven processes that enable the ability to reach optimized solutions

	▪ Reception of specific knowledge and skills about integrative data driven building and façade design and integration of value engineering methods in computable algorithms ▪ gain specific knowledge of application of concepts learnt in parallel modules on computational and building design trough automated processes (optimization, simulation, programming) ▪ discuss, evaluate and support the development of different solutions for challenging automated processes in an overall design approach for a case-study building ▪ Application of the presented contents in design, visualisation and execution drawings for the given situation, Presentation and discussion of the results in the plenum.
Contents of Study	▪ Overview of technological requirements and detail aspects, especially integration of digital processes into the design ▪ Lectures on specific integration of management-tools including BIM, CAD-CAM, manufacturing and process of production line, assembly on-site (tolerances, just in time handling, problems according to other trades, assembling etc.) and on case-studies about successful integration of algorithmic approaches to reach optimized engineered buildings ▪ Application of advanced, adaptive and generative 3D modelling and presentation tools (software) in architectural design and planning
Forms of Exams	Mid-term and final presentation, Elaboration with presentation and colloquium
Literature	▪ Agkathidis A., Schillig G., Hudert M., (2007). Form Defining Strategies, experimental architectural design. Wasmuth Ernst Verlag ▪ Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I., & Angel, S. (1977). A Pattern Language: Towns, Buildings, Construction (Center for Environmental Structure). ▪ Barthel, R., & Nerdinger, W. (2010). Wendepunkte im Bauen: von der seriellen zur digitalen Architektur; [anlässlich der Ausstellung... im Architekturmuseum der TU München in der Pinakothek der Moderne, 18. März bis 13. Juni 2010]. Detail, Inst. für Internat. Architekturdokumentation. ▪ BIG – Bjarke Ingels Group (2015). BIG Hot to Cold: An Odyssey of Architectural Adaptation ▪ Dunne, A., & Raby, F. (2013). Speculative everything: design, fiction, and social dreaming. MIT Press. ▪ Menges, A., & Ahlquist, S. (2011). Computational Design Thinking: Computation Design Thinking. John Wiley & Sons ▪ Menges, A. (2012). Material computation: Higher integration in morphogenetic design. Architectural Design, 82(2), 14-21. ▪ Moussavi, F. (2009). The Function of Form. Kubo, M.; Ambrose, G.; Fortunato, B.; Ludwig, R.; Schricker, A. (eds.) Harvard Graduate School of Design/Actar, 2009 ▪ Peters, T., & Peters, B. (2013). Inside Smartgeometry: expanding the architectural possibilities of computational design. John Wiley & Sons. ▪ Oxman, R., & Oxman, R. (2010). New structuralism: design, engineering and architectural technologies. Architectural Design, 80(4), 14-23.

	▪ Oxman, R., & Oxman, R. (2014). Theories of the Digital in Architecture. Routledge. ▪ Pottmann, H. (2010). Architectural geometry as design knowledge. Architectural Design, 80(4), 72-77

Module Title	**Digital Tools I**			
Module Number	**MID 1020**			
Module Responsibility	Prof. Dipl.-Ing. Hans Sachs, Prof. i.V. Andrea Kondziela			
Lecturer	Prof. Dipl.-Ing. Hans Sachs, Prof. i.V. Andrea Kondziela, Prof. Markus Schein, Dipl.-Ing. David Lemberski, wiss. MA, Lehrbeauftragte			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module MIAD/MID	x	Compulsory Module	
Semester	1			
Forms of Teaching	Lecture, seminar			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	2	Other	2
Workload (h)	Lecture	30	Laboratory	
	Seminar	30	Workshop	
	Excursion		Work Experience	
	Self-Study	100	Exam Preparation	20
Workload total (h)	180			
Credits	6			
Prerequisites	None			
Focus on the Sustainability Goals (17 UN SGDs)	The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. The Professorship of CAAD respectively to its activities in the Master of Integrated Design and the Master of Integrated Architectural Design sets a strong focus on a sustainable digital transformation in the building sector and especially integrates the following Sustainable Development Goals of the UN into its curriculum: ▪ Good Health and Well-Being In the built environment materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and well beeing. Here digital technologies provide a vast field of potential for the support of planning, building and controlling processes with accurate and widely data-based analysis, calculation, simulation and generation of architectural space. ▪ Affordable and Clean Energy A large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to have less			

	negative impact on the world's climate. Thus planning and building must develop and integrate new energy and resource efficient technologies, material efficiency and consciousness. As well it must support and protect natural ecosystems. Digital tools and methods can enable, trigger, integrate, calculate and support concepts with a focus on energy efficiency in architecture. ▪ Industry, Innovation and Infrastructure Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of the digital transformation in building construction needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ Sustainable Cities and Communities Large Cities will be the key drivers of developments for Intelligently and socially digitized, sustainable habitats in the future as they are the main polluters, energy consumers and hot spots for social inequality today. New concepts and rule-sets for a cohabitation of vegetation, humans, animals and robots need to be mindfully explored, tested and applied. ▪ Responsible Consumption and Production An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. In this intertwined system of a future digital production, use and consumption in the built environment new concepts for (digital) process chains need to be explored and developed. ▪ Climate Action Digital Tools (Software) and related Methods represent a comprehensive source for optimization, monitoring, documentation and control of architectural spaces as well as building components. When integrated and applied well, they have a large potential to reduce, reflect, detect and adjust climate-damaging effects in the building industry. They can have a positive impact through digital planning & fabrication, house automation (smart home) and digitized re-use and recycling processes. ▪ Partnership for the Goals The Digitalization of research networks enables global, faster and further reaching communication, documentation and (knowledge) exchange on the processes and goals mentioned above. The focus of the University lies on the development of more exchange in study programs, students, teaching staff, facilities and research activities, especially on initiatives on more sustainability.
Goal of study and Competences	▪ Basic to advanced knowledge of the architectural theory discussion on the use of digital methods and tools in design and fabrication processes of the built environment. ▪ Gaining experience in the experimental and interdisciplinary exploration of digital tools in the context of architectural

	planning, fabrication and building automation with a focus on sustainability. ▪ Comprehensive knowledge about software applications in the area of professional image editing, 3D-modeling, generative and adaptive modeling processes and the use of related software tools, such as Rhino + Grasshopper, Processing, Generative Clouds, VW Marionette, Revit (+Dynamo), Digital Project (Catia) etc. ▪ Development of basic competences in programming and generative modeling based on visual and higher programming languages for designers ▪ Project-oriented application of software in the fields of visualization and modeling and basic experience with software their interfaces.
Contents of Study	▪ The lecture presents various computer-based design, development and fabrication processes in the field of building design and construction as well as industrial design ▪ Various examples of digital design processes within the context of digital networking and modeling will be presented and explored on a methodological and a project-related level. ▪ In the exercises, software applications from the fields of 3D Modeling' and the more advanced 'Generative Modeling' will possibly be applied within the context project modules of the study program. In addition, potentials of the use of programming (scripting) in the industrial design and building design context will be exemplarily presented. ▪ Interfaces of different software applications and computer-assisted manufacturing techniques from the above-mentioned areas and their application are presented and implemented in a project-oriented manner. Hereby the presented tools and methods are put into a theoretical and practical context using examples and scenarios. ▪ In the exercises, links between design, development and production processes as well as the interfaces of physical and virtual objects and rooms are presented and exemplified.
Forms of Exams	elaborations, presentations, oral examination, written examination
Literature	▪ Beorkrem, C. (2012). Material Strategies in Digital Fabrication, Routledge ▪ Jabi W., Johnson, B., Woodbury, R. (2013) Parametric Design for Architecture, Laurence King Publishing ▪ Shiffman, D. (2015), Learning Processing: A Beginner's Guide to Programming Images, Animation, and Interaction, Morgan Kaufmann ▪ Reas, C., & McWilliams, C. (2010). Form+ code: In design, art, and architecture. Princeton Architecturel Press ▪ Jackson, P. (2011), Folding Techniques for Designers: From Sheet to Form, Laurence King Publishing ▪ Bohnacker, H., Groß, B., Laub, J., Gross, B., Laub, J., & Lazzeroni, C. (2009). Generative Gestaltung: entwerfen, programmieren, visualisieren. C. Lazzeroni (Ed.). Mainz: Schmidt.

	▪ Reas, C., & Fry, B. (2007). Processing: a programming handbook for visual designers and artists (Vol. 6812). Mit Press. ▪ Dunn, N. (2012), Digital Fabrication in Architecture, Laurence King Publish. ▪ Menges, A., Ahlquist, S. (2011). Computational Design Thinking: Computation Design Thinking. John Wiley & Sons ▪ Agkathidis A.,., (2012). Computational Architecture: digital design tools and manufacturing techniques. BIS Publishers ▪ Hodson, R. (2014), Ry's Git Tutorial, RyPress ▪ Terzidis, K. (2009). Algorithms for visual design using the processing language. John Wiley & Sons. ▪ Serres,B. (2014). Thumbelina: The Culture and Technology of Millennials. Rowman & Littlefield International

Module Title	Construction and Dimensioning			
Module Number	**MID 1030**			
Module Responsibility	Prof. Dipl.-Ing. Jens-Uwe Schulz			
Lecturer	Prof. Dipl.-Ing. Jens-Uwe Schulz, N.N.			
Course of Study	Master Integrated Design (MID) Master Architektur (MA)			
Status	Mandatory Module C	x	Compulsory Module	
Semester	1			
Forms of Teaching	Lecture and exercise, seminar			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	2	Other	2
Workload (h)	Lecture	30	Laboratory	
	Seminar	30	Workshop	
	Excursion		Work Experience	
	Self-Study	80	Exam Preparation	40
Workload total (h)	180			
Credits	6			
Prerequisites	None			
Focus on the Sustainability Goals (17 UN SGDs)	▪ **Ensure healthy lives and promote well-being for all at all ages (Goal 3)** Architecture and the built environment directly affect our health and well-being on various scales. Materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and emotions. In this context the dimensioning of Constructions can support with accurate and widely data-based analysis, calculation, simulation and generation of architectural space with a strong focus on sustainable solutions. ▪ **Ensure access to affordable, reliable, sustainable and modern energy for all (Goal 7)** A dominantly large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to become more climate friendly. Therefor architecture must develop and integrate new energy and resource efficient technologies, material consciousness and support natural ecosystems. Construction design methods are capable to enable, trigger, integrate and support new energy concepts in architecture. ▪ **Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (Goal 9)**			

	Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of new developments in (industrial) building construction needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ **Ensure sustainable consumption and production patterns (Goal 12)** An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. Construction design and Production are intertwined ▪ **Take urgent action to combat climate change and its impacts (Goal 13)** A well structural design can help to reduce primary energy consumption. ▪ **Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Developmen (Goal 17)** Sustainable building uses the strength of networks and international partnerships to develop common solutions and to implement them in concrete terms.
Goal of study and Competences	• Deepen the basic knowledge about load bearing and deformation behavior of primary structures and constructions of buildings Students should be able to independently develop and analyze complex primary constructions and special constructions within the scope of design tasks, as well as to be able to define requirements and interfaces with the planners • In addition, they should be able to formulate and apply assessment criteria for primary constructions, in particular with regard to the overall design concept. • Recognize and quantify the essential requirements of structural designs. • Approximate dimensioning of supporting structures
Contents of Study	• The lecture provides an overview of the morphology of the primary and special constructions regarding mechanical, constructive, functional, material and design aspects. • Furthermore the basic principles of the analysis methods are mediated and assessment and assessment methods are discussed. • In the accompanying exercises, the content of the lecture will be deepened by means of concrete models and calculation programs. • One-semester assignment, which is to be presented in the exam, is practiced independently
Forms of Exams	Elaboration and Colloquium
Literature	• Schulz, J.-U.: Construction and Dimensioning. Script • Arya, C.: Design of Structural Elements: Concrete, Steelwork, Masonry and Timber Designs to British Standards and Eurocodes. 3. Edition, CRC Press, 2009 • Braycott, T.; Bullman, P.: Structural Elements Design Manual. Working with Eurocodes. 2. Edition, Routledge, 2013 • Engel, H.: Tragsysteme/Structure Systems. 3. Aufl., Hatje Cantz, 2007 (deutsch/englisch)

	• Garrison, P.: Basic Structures. 3. Edition, Wiley Blackwell, 2016 • McKenzie, W. M. C.: Design of Structural Elements to Eurocodes. 2. Edition, Palgrave Macmillan, 2013 • Ochshorn, J.: Structural Elements for Architects and Builders: Design of Columns, Beams, and Tension Elements in Wood, • Steel, and Reinforced Concrete. 2. Edition, Common Ground Publishing, 2015 • Schodek, D. L.; Brechthold, M.: Structures. 7. Edition, Pearson, 2014 • Watts, A.: Modern Contruction Handbook. 4. Edition, Birkhäuser, 2016

Module Title	Sustainability, Climate and Comfort			
Module Number	**MID 1040**			
Module Responsibility	Prof. Dipl.-Ing. Daniel Arztmann			
Lecturer	Prof. Dipl.-Ing. Daniel Arztmann, wiss. Mitarbeiter, Lehrbeauftragte, Industry Experts, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module FD	x	Compulsory Module	
Semester	1			
Forms of Teaching	Lecture and exercise, seminar, workshop			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	2	Other	3
Workload (h)	Lecture	30	Laboratory	
	Seminar	30	Workshop	15
	Excursion		Work Experience	
	Self-Study	80	Exam Preparation	25
Workload total (h)	180			
Credits	6			
Prerequisites	None			
Focus on the Sustainability Goals (17 UN SGDs)	▪ Good Health and Well-Being Building envelopes contribute to urban health and well-being as well as to a comfortable and healthy interior living on a large scale. ▪ Affordable and Clean Energy A well and careful designed, manufactured and installed façade has a huge impact on the operational and embodied energy consumption of a building. With the inclusion of photovoltaics and wind power it can be used for renewable energy production. ▪ Industry, Innovation and Infrastructure Considering local conditions and cultural characteristics in façade product and building design help to build a resilient infrastructure. Principles like design from / for recycling, the development of refurbishment and reuse strategies and the implementation of renewable energy concepts in the design of new products foster sustainable industrialization and innovation. ▪ Climate Action The reduction of operational and embodied energy consumption leads to an improved Co² foodprint of a building what helps to mitigate climate change. Furthermore, resilient building envelopes are designed to withstand changing			

	weather conditions and the direct impacts of the climate change like hurricanes, strong rains, hail, high temperatures.
Goal of study and Competences	▪ gain specific knowledge and skills about sustainable and climate adaptive building and facade design ▪ gain specific knowledge about project design and planning with regards to aspects of sustainability and building physics ▪ further discussion and detailed development of the representative design project (MID P4) as an sustainable, climate adapted and comfortable building ▪ apply the presented contents in different software and simulation of climatic behaviour for the given situation ▪ present and discuss the results in the plenum.
Contents of Study	▪ lectures on different aspects concerning sustainability, climate and comfort in building and façade design: sustainability aspects and certifications, operational and embodied energy in building and façade design, physical principles of facades including thermal, acoustic and solar protection, comfortable and healthy outdoor and interior spaces ▪ seminars and workshops to review and discuss the application of the taught content on the representative design project (from MID P4) ▪ trainings on specific software tools: e.g. Schüco BPS, climate studio, flixo, excel tools.
Forms of Exams	Elaboration and presentation
Literature	▪ Scripts, company's records and documents at Ilias ▪ Cremers Jan et al (2016). Building Openings Construction Manual. Munich. DETAIL Verlag ▪ Duzia, Bogusch (2012). Basiswissen Bauphysik – Grundlagen des Wärme und Feuchteschutzes, Stuttgart: Fraunhofer IRB Verlag ▪ Hausladen, Gerhard et al (2011). Building to Suit the Climate – A Handbook. Basel: Birkhäuser Verlag. ▪ Henns, Hugo et al (2017). Building Physics: Heat, Air and Moisture: Fundamentals and Engineering Methods, Berlin: Ernst & Sohn Verlag ▪ Herzog, Thomas et al (2021). Facade Construction Manual. Munich: DETAIL Verlag. ▪ Heusler, Winfried et al (2013). Building Envelopes for the 21st Century; Munich: Institut für Internationale Architektur-Dokumentation ▪ Hindrichs, Dirk U. (2007). Plusminus 20°/40° latitude - Sustainable Building Design in Tropical and Subtropical Regions. Stuttgart / London, Edition Axel Menges ▪ Kesik, Ted (2019). Thermal Resilience Design Guide, Online Ressource: https://pbs.daniels.utoronto.ca/faculty/kesik_t/PBS/Kesik-Resources/Thermal-Resilience-Guide-v1.0-May2019.pdf ▪ Knaack, Ulrich et al (2018). Building Physics of the Envelope: Principles of Construction, Basel: Birkhäuser ▪ Lienhard, John H. (2020). A Heat Transfer Textbook, Cambridge: Published by Phlogiston Press, Online Ressource: https://ahtt.mit.edu/wp-content/uploads/2020/08/AHTTv510.pdf

	▪ Schüco Int. KG (2021), Architect Information 15 – Building Materials, Structure and Building Physics, Online Ressource

Module Title	**Programming and Simulation**			
Module Number	**MID 1050**			
Module Responsibility	Prof. Dipl.-Ing. Jens-Uwe Schulz			
Lecturer	Prof. Dipl.-Ing. Jens-Uwe Schulz, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module CD	x	Compulsory Module	
Semester	1			
Forms of Teaching	Lecture and exercise			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	2	Other	2
Workload (h)	Lecture	30	Laboratory	
	Seminar	20	Workshop	
	Excursion		Work Experience	
	Self-Study	80	Exam Preparation	40
Workload total (h)	180			
Credits	6			
Prerequisites	None			
Focus on the Sustainability Goals (17 UN SGDs)	▪ **Ensure healthy lives and promote well-being for all at all ages (Goal 3)** Architecture and the built environment directly affect our health and well-being on various scales. Materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and emotions. In this context the Programming and Simulation methods can support with accurate and widely data-based analysis, calculation, simulation and generation of architectural space with a strong focus on sustainable solutions. ▪ **Ensure access to affordable, reliable, sustainable and modern energy for all (Goal 7)** A dominantly large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to become more climate friendly. Therefor architecture must develop and integrate new energy and resource efficient technologies, material consciousness and support natural ecosystems. Programming and Simulation methods are capable to enable, trigger, integrate and support new energy concepts in architecture. ▪ **Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (Goal 9)**			

	Industry, innovation and available infrastructure play a central role in the realization of architectural projects. Advanced Programming methods helps to design new developments in (industrial) building construction needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ **Ensure sustainable consumption and production patterns (Goal 12)** An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. Programming and Simulation methods and Production are intertwined ▪ **Take urgent action to combat climate change and its impacts (Goal 13)** Programming and Simulation methods can help to reduce energy consumption. ▪ **Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Developmen (Goal 17)** Sustainable building uses the strength of networks and international partnerships to develop common solutions and to implement them in concrete terms.
Goal of study and Competences	• Developing a basic competence in programming. • Learning programming processes with a view to writing a program of your own. • Overview information on the engineering fundamentals of numerical Simulation methods for the finding of form and the thermo-dynamic properties of building components. • Survey of specific software products and their interfaces with other planning software products (architecture, load-bearing structures, building integrated services). • Ability to choose and apply engineering planning tools for the establishment of parameters and internal forces in the area of structural planning and building physics.
Contents of Study	• Basic knowledge of programming based on Python in application-oriented seminars. • Basic elements of common simulation methods (FEM, CFD, FDM, CAO, SKO). • Introduction to and application of specific software including its interface with other planning software products. • Application to simple, practical problems. • Teaching of basic knowledge in the use of specific software applications from the areas of the planning of load-bearing structures and building physics. • Investigation of the planning interfaces between architect and planners using practical problems
Forms of Exams	Elaboration and Colloquium
Literature	• Schulz, J.-U.: Programming and Simulation. Script • Fangohr,H.: Introduction to Python for Computational Science and Engineering 2022 • Fish, J.; Belytschko, T.: A First Course in Finite Elements. John Wiley & Sons 2007 • Halterman, R. L.: Fundamentals of Python Programming. 2016 • Issa, R: Essential Mathematics 4th Edition, 2019

	• Johansson, R.: Numerical Python - A Practical Techniques Approach for Industry. Apress, 2nd Edition, 2019 • Khennane, A.: Introduction to finite element analysis using MATLAB and Abaqus. CRC Press, 2013 • Langtangen, H. P: A Primer on Scientific Programming with Python: Springer, 5th Edition, 2016 • Linge, S.; Langtangen, H. P.: Programming For Computations-Python 2nd Edition 2020 • Malthe-Sørenssen, A.: Elementary Mechanics Using Python. Springer, 2015 • Pottmann, H.: Architectural Geometry, 2007

Module Title	Integrated Facade Design			
Module Number	MID 2000			
Module Responsibility	Prof. Dipl.-Ing. Daniel Arztmann			
Lecturer	Prof. Dipl.-Ing. Daniel Arztmann, Prof. Dipl.-Ing. Hans Sachs, wiss. Mitarbeiter, Lehrbeauftragte, Industry Experts, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module FD	x	Compulsory Module	
Semester	2			
Forms of Teaching	Lecture, seminar, workshop			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	1	Other	3
Workload (h)	Lecture	15	Laboratory	
	Seminar		Workshop	30
	Excursion	15	Work Experience	
	Self-Study	270	Exam Preparation	30
Workload total (h)	360			
Credits	12			
Prerequisites	Modules of Semester 1			
Focus on the Sustainability Goals (17 UN SGDs)	▪ Good Health and Well-Being Building envelopes contribute to urban health and well-being as well as to a comfortable and healthy interior living on a large scale. ▪ Affordable and Clean Energy A well and careful designed, manufactured and installed façade has a huge impact on the operational and embodied energy consumption of a building. With the inclusion of photovoltaics and wind power it can be used for renewable energy production. ▪ Industry, Innovation and Infrastructure Considering local conditions and cultural characteristics in façade product and building design help to build a resilient infrastructure. Principles like design from / for recycling, the development of refurbishment and reuse strategies and the implementation of renewable energy concepts in the design of new products foster sustainable industrialization and innovation. ▪ Climate Action The reduction of operational and embodied energy consumption leads to an improved Co^2 foodprint of a building what helps to mitigate climate change. Furthermore, resilient building envelopes are designed to withstand changing			

	weather conditions and the direct impacts of the climate change like hurricanes, strong rains, hail, high temperatures.
Goal of study and Competences	▪ The project aims at exemplifying an integrative, methodical and at the same time individual approach to the design and engineering process. ▪ A reflected interaction with the environment and responsible use of resources as well as consideration of the future development of society and technology are encouraged in the process. ▪ The ability to present the project conception orally and on paper in a clear and appropriate way as well as critical reflection of what has been achieved are important goals of the course. Understanding the development of building envelopes related to cultural and climatic conditions and in history and as part of the architectural design process ▪ Understanding the complexity of building envelopes and facades related to functions, systems, materials and production ▪ Evaluating the conceptual and technical advantages and disadvantages of different façade systems based on digitally driven engineering methods ▪ In the ensuing engineering process, specific relevant parameters and their potentially conflicting consequences are investigated in detail to support the architectural design decisions ▪ A special focus is on the use of digital methods in the sustainable design and engineering process
Contents of Study	▪ The project is the focal point of the second semester. It centers on supporting the design of a building serving a variety of functions set in a specific urban location. ▪ Individual presentations on selected topics are held in the course of the seminar with a strong focus on sustainability and digitally driven analysis, design and construction ▪ Materials and details and specific calculations are considered in relevant number. Models and simulations are required. ▪ Variant discussion of façade solutions at various stages of an architectural project development. ▪ Concept design of an architectural project and in-depth design and engineering of the facade with special emphasis to the construction process
Forms of Exams	Elaboration, presentation
Literature	▪ Scripts, company's records and documents at Ilias ▪ Ching, Francis D.K. (2020). Building Construction Illustrated, New Jersey: Wiley Verlag ▪ Compagno, Andrea (2002). Intelligent Glass Facades. Berlin: Birkhäuser ▪ Cremers Jan et al. (2016). Building Openings Construction Manual. Munich. DETAIL Verlag ▪ Hausladen, Gerhard et al. (2011). Building to Suit the Climate – A Handbook. Basel: Birkhäuser Verlag. ▪ Herzog, Thomas et al. (2021). Facade Construction Manual. Munich: DETAIL Verlag.

	▪ Hindrichs, Dirk U. (2007). Plusminus 20°/40° latitude, Sustainable Building Design in Tropical and Subtropical regions, Stuttgart: Edition Axel Menges ▪ Knaack, Ulrich et al. (2012). Principles of Construction - Facades. Basel: Birkhäuser Verlag. ▪ Knaack, Ulrich et al. (2022). JFDE - Journal of Facade Design and Engineering, Online Ressource: https://www.jfde.eu/index.php/jfde/index ▪ Köhler, Manfred (2012), Handbuch Bauwerksbegrünung, Köln: Rudolg Müller Verlag ▪ Oesterle, Eberhard et al. (2001). Double-Skin Facades. Prestel Verlag ▪ Pfoser, Nicole et al. (2014), Gebäude, Begrünung, Energie, Bonn: FLL ▪ Pottgiesser, Uta (2004). Fassadenschichtungen Glas. Berlin: Bauwerk Verlag ▪ Rice, Peter et al. (1995). Transparente Architektur – Glasfassaden mit Structural Glazing, Basel : Birkhäuser Verlag ▪ Schröpfer, Thomas et al. (2011). Material Design – Informing Architecture by Materiality, Basel: Birkhäuser Verlag

Module Title	Computational Architectural Design II			
Module Number	MID 2010			
Module Responsibility	Prof. Hans Sachs, Prof.’in Andrea Kondziela			
Lecturer	Prof. Hans Sachs, Prof.’in Andrea Kondziela, Prof. Markus Schein, Lehrbeauftragte, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module	x	Compulsory Module	
Semester	2			
Forms of Teaching	Design Studio with lectures, seminar and desk crits, literature on digital media (via ILIAS)			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	1	Other	5
Workload (h)	Lecture	15	Laboratory	
	Seminar	30	Workshop	45
	Excursion		Work Experience	
	Self-Study	240	Exam Preparation	30
Workload total (h)	360			
Credits	12			
Prerequisites	None			
Focus on the Sustainability Goals (17 UN SGDs)	The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. The Professorship of CAAD respectively to its activities in the Master of Integrated Design and the Master of Integrated Architectural Design sets a strong focus on a sustainable digital transformation in the building sector and especially integrates the following Sustainable Development Goals of the UN into its curriculum: ▪ Good Health and Well-Being In the built environment materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and well beeing. Here digital technologies provide a vast field of potential for the support of planning, building and controlling processes with accurate and widely data-based analysis, calculation, simulation and generation of architectural space. ▪ Affordable and Clean Energy A large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to have less negative impact on the world’s climate. Thus planning and			

	building must develop and integrate new energy and resource efficient technologies, material efficiency and consciousness. As well it must support and protect natural ecosystems. Digital tools and methods can enable, trigger, integrate, calculate and support concepts with a focus on energy efficiency in architecture. ▪ Industry, Innovation and Infrastructure Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of the digital transformation in building construction needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ Sustainable Cities and Communities Large Cities will be the key drivers of developments for Intelligently and socially digitized, sustainable habitats in the future as they are the main polluters, energy consumers and hot spots for social inequality today. New concepts and rule-sets for a cohabitation of vegetation, humans, animals and robots need to be mindfully explored, tested and applied. ▪ Responsible Consumption and Production An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. In this intertwined system of a future digital production, use and consumption in the built environment new concepts for (digital) process chains need to be explored and developed. ▪ Climate Action Digital Tools (Software) and related Methods represent a comprehensive source for optimization, monitoring, documentation and control of architectural spaces as well as building components. When integrated and applied well, they have a large potential to reduce, reflect, detect and adjust climate-damaging effects in the building industry. They can have a positive impact through digital planning & fabrication, house automation (smart home) and digitized re-use and recycling processes. ▪ Partnership for the Goals The Digitalization of research networks enables global, faster and further reaching communication, documentation and (knowledge) exchange on the processes and goals mentioned above. The focus of the University lies on the development of more exchange in study programs, students, teaching staff, facilities and research activities, especially on initiatives on more sustainability.
Goal of study and Competences	▪ Preparation for computational designer´s or consultant's work: support the concept making and decision finding of the architectural design, communication of relevant content (construction, structure, materials, building physics, building services) related to the architectural and computer driven processes that enable the ability to reach optimized solutions

	▪ Reception of specific knowledge and skills about integrative data driven building and façade design and integration of value engineering methods in computable algorithms ▪ gain specific knowledge of application of concepts learnt in parallel modules on computational and building design trough automated processes (optimization, simulation, programming) ▪ discuss, evaluate and support the development of different solutions for challenging automated processes in an overall design approach for a case-study building ▪ Application of the presented contents in design, visualisation and execution drawings for the given situation, Presentation and discussion of the results in the plenum.
Contents of Study	▪ Overview of technological requirements and detail aspects, especially integration of digital processes into the design ▪ Lectures on specific integration of management-tools including BIM, CAD-CAM, manufacturing and process of production line, assembly on-site (tolerances, just in time handling, problems according to other trades, assembling etc.) and on case-studies about successful integration of algorithmic approaches to reach optimized engineered buildings ▪ Application of advanced, adaptive and generative 3D modelling and presentation tools (software) in architectural design and planning
Forms of Exams	Mid-term and final presentation, Elaboration with presentation and colloquium
Literature	▪ Agkathidis A., Schillig G., Hudert M., (2007). Form Defining Strategies, experimental architectural design. Wasmuth Ernst Verlag ▪ Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I., & Angel, S. (1977). A Pattern Language: Towns, Buildings, Construction (Center for Environmental Structure). ▪ Barthel, R., & Nerdinger, W. (2010). Wendepunkte im Bauen: von der seriellen zur digitalen Architektur; [anlässlich der Ausstellung... im Architekturmuseum der TU München in der Pinakothek der Moderne, 18. März bis 13. Juni 2010]. Detail, Inst. für Internat. Architekturdokumentation. ▪ BIG – Bjarke Ingels Group (2015). BIG Hot to Cold: An Odyssey of Architectural Adaptation ▪ Dunne, A., & Raby, F. (2013). Speculative everything: design, fiction, and social dreaming. MIT Press. ▪ Menges, A., & Ahlquist, S. (2011). Computational Design Thinking: Computation Design Thinking. John Wiley & Sons ▪ Menges, A. (2012). Material computation: Higher integration in morphogenetic design. Architectural Design, 82(2), 14-21. ▪ Moussavi, F. (2009). The Function of Form. Kubo, M.; Ambrose, G.; Fortunato, B.; Ludwig, R.; Schricker, A. (eds.) Harvard Graduate School of Design/Actar, 2009 ▪ Peters, T., & Peters, B. (2013). Inside Smartgeometry: expanding the architectural possibilities of computational design. John Wiley & Sons. ▪ Oxman, R., & Oxman, R. (2010). New structuralism: design, engineering and architectural technologies. Architectural Design, 80(4), 14-23.

	▪ Oxman, R., & Oxman, R. (2014). Theories of the Digital in Architecture. Routledge. ▪ Pottmann, H. (2010). Architectural geometry as design knowledge. Architectural Design, 80(4), 72-77

Module Title	Digital Tools II			
Module Number	MID 2020			
Module Responsibility	Prof. Jens-Uwe Schulz, Prof. Hans Sachs, Prof.'in Andrea Kondziela			
Lecturer	Prof. Jens-Uwe Schulz, Prof. Hans Sachs, Prof. Jens-Uwe Schulz, Prof.'in Andrea Kondziela, wiss. Mitarbeiter und Lehrbeauftragte, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module	x	Compulsory Module	
Semester	2			
Forms of Teaching	Lecture, Seminar, Workshops			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	2	Other	2
Workload (h)	Lecture	30	Laboratory	
	Seminar	15	Workshop	15
	Excursion		Work Experience	
	Self-Study	100	Exam Preparation	20
Workload total (h)	180			
Credits	6			
Prerequisites	Digital Tools and Methods I			
Focus on the Sustainability Goals (17 UN SGDs)	The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. The Professorship of CAAD respectively to its activities in the Master of Integrated Design and the Master of Integrated Architectural Design sets a strong focus on a sustainable digital transformation in the building sector and especially integrates the following Sustainable Development Goals of the UN into its curriculum: ▪ Good Health and Well-Being In the built environment materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and well beeing. Here digital technologies provide a vast field of potential for the support of planning, building and controlling processes with accurate and widely data-based analysis, calculation, simulation and generation of architectural space. ▪ Affordable and Clean Energy A large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to have less			

	negative impact on the world's climate. Thus planning and building must develop and integrate new energy and resource efficient technologies, material efficiency and consciousness. As well it must support and protect natural ecosystems. Digital tools and methods can enable, trigger, integrate, calculate and support concepts with a focus on energy efficiency in architecture. ▪ Industry, Innovation and Infrastructure Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of the digital transformation in building construction needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ Sustainable Cities and Communities Large Cities will be the key drivers of developments for Intelligently and socially digitized, sustainable habitats in the future as they are the main polluters, energy consumers and hot spots for social inequality today. New concepts and rule-sets for a cohabitation of vegetation, humans, animals and robots need to be mindfully explored, tested and applied. ▪ Responsible Consumption and Production An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. In this intertwined system of a future digital production, use and consumption in the built environment new concepts for (digital) process chains need to be explored and developed. ▪ Climate Action Digital Tools (Software) and related Methods represent a comprehensive source for optimization, monitoring, documentation and control of architectural spaces as well as building components. When integrated and applied well, they have a large potential to reduce, reflect, detect and adjust climate-damaging effects in the building industry. They can have a positive impact through digital planning & fabrication, house automation (smart home) and digitized re-use and recycling processes. ▪ Partnership for the Goals The Digitalization of research networks enables global, faster and further reaching communication, documentation and (knowledge) exchange on the processes and goals mentioned above. The focus of the University lies on the development of more exchange in study programs, students, teaching staff, facilities and research activities, especially on initiatives on more sustainability.
Goal of study and Competences	▪ The Capability to understand, setup and manage collaborative, interdisciplinary workflows related to generative and integrative building modelling processes.

	▪ The Competence to work in a Common Data Environment from design to construction based on the principles of Building Information Modeling (BIM) ▪ Skills to operate with different AEC modelling and planning software applications and understanding of different CAD-based data standards and their administration through universal data interfaces.
Contents of Study	▪ Lectures on theoretical and international aspects of BIM standards (ISO16739, ÖNorm, Pas1192, DIN91400, VDI 2552, etc.) with praxis related applications and tendencies of computerbased planning and fabrication processes. ▪ The introduction and discussion of a representative case-study for an interdisciplinary workflow explaining native vs. standardized file formats, external / open data sources. ▪ Individual software applications to store information in their native formats, imposing challenges in the AEC industry to make information available to project stakeholders, ▪ The presentation and application of digital design methodologies, software systems, information and communication technologies to address effective exchange of data between software applications such as middleware software, exchange file formats developed by individual proprietary software vendors such as DXF (Data eXchange Format), standards and open-specification data models like XML (eXtensible Markup Language), IFC (Industry Foundation Classes), Web Services, ICT, project model servers, and semantic Web applications (i.e. Flux.io etc.)
Forms of Exams	Elaboration and Colloquium
Literature	▪ Breit, Manfred (2010). Digital Simulation in Lean Project Development. ▪ Breit, Manfred (2010). Process oriented model based information exchange between architecture and fabrication in early project phases. ▪ Crotty, R. (2013). The impact of building information modelling: transforming construction. Routledge. ▪ Deutsch, R. (2011). BIM and integrated design: strategies for architectural practice. John Wiley & Sons. ▪ Eastman, C., Eastman, C. M., Teicholz, P., & Sacks, R. (2011). BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons. ▪ Ernst & Sohn Special (2014). BIM – Bulding Information Modeling, ▪ Graham, Peter C. (2012). Optimization in Architecture through a Synthesis of Design, Analysis and Fabrication, ▪ Günthner, W. A., & Borrmann, A. (Eds.). (2011). Digitale Baustelle-innovativer Planen, effizienter Ausführen: Werkzeuge und Methoden für das Bauen im 21. Jahrhundert. Springer-Verlag ▪ Hardin, B., & McCool, D. (2015). BIM and construction management: proven tools, methods, and workflows. John Wiley & Sons. ▪ Holzer, D. (2015). The BIM Manager's Handbook, Part 1: Best Practice BIM. John Wiley & Sons.

	▪ Industrieallianz für Interoperabilität e.V. (2008). Building Smart Anwenderhandbuch, Datenaustausch BIM/IFC. ▪ ISO 16739 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries, first edition 2013-04-01 ▪ Junge, R. (Ed.). (2012). CAAD Futures 1997: Proceedings of the 7th International Conference on Computer Aided Architectural Design Futures Held in Munich, Germany, 4–6 August 1997. Springer Science & Business Media. ▪ Leicht, Robert (2007). Moving toward an intelligent shop modeling process. ▪ Race, S. (2012). BIM demystified. Riba Publishing. ▪ Reinhardt, Jan (2015). Level of Development Specification

Module Title	Theory and Sustainable Construction			
Module Number	**MID 2030**			
Module Responsibility	Prof. Dipl.-Ing. Jens-Uwe Schulz			
Lecturer	Prof. Dipl.-Ing. Jens-Uwe Schulz, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module	x	Compulsory Module	
Semester	2			
Forms of Teaching	Lecture, Seminar			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	2	Other	2
Workload (h)	Lecture	30	Laboratory	
	Seminar	30	Workshop	
	Excursion		Work Experience	
	Self-Study	100	Exam Preparation	20
Workload total (h)	180			
Credits	6			
Prerequisites	None			
Focus on the Sustainability Goals (17 UN SGDs)	▪ **Ensure healthy lives and promote well-being for all at all ages (Goal 3)** In the built environment materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and well beeing. Here digital technologies provide a vast field of potential for the support of planning, building and controlling processes with accurate and widely data-based analysis, calculation, simulation and generation of architectural space. Additionally, carefully designed building envelopes contribute to urban health and well-being as well as to a comfortable and healthy interior living on a large scale. ▪ **Ensure access to affordable, reliable, sustainable and modern energy for all (Goal 7)** A large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to have less negative impact on the world's climate. Thus planning and building must develop and integrate new energy and resource efficient technologies, material efficiency and consciousness. As well it must support and protect natural ecosystems. Digital tools and methods can enable, trigger, integrate, calculate and support concepts with a focus on energy efficiency in architecture. Well and careful designed, manufactured and installed building envelopes have huge impacts on the operational and embodied energy consumption of a building.			

	With the inclusion of photovoltaics and wind power it can be used for renewable energy production. ▪ **Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (Goal 9)** Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of the digital transformation in building construction and façade design needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. **Make cities and human settlements inclusive, safe, resilient and sustainable (Goal 11)** Large Cities will be the key drivers of developments for Intelligently and socially digitized, sustainable habitats in the future as they are the main polluters, energy consumers and hot spots for social inequality today. New concepts and rule-sets for a cohabitation of vegetation, humans, animals and robots need to be mindfully explored, tested and applied. ▪ **Ensure sustainable consumption and production patterns (Goal 12)** An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. Construction design and Production are intertwined ▪ **Take urgent action to combat climate change and its impacts (Goal 13)** An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. In this intertwined system of a future digital production, use and consumption in the built environment new concepts for (digital) process chains need to be explored and developed. ▪ **Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Developmen (Goal 17)** The Digitalization of research networks enables global, faster and further reaching communication, documentation and (knowledge) exchange on the processes and goals mentioned above. The focus of the University lies on the development of more exchange in study programs, students, teaching staff, facilities and research activities, especially on initiatives on more sustainability.
Goal of study and Competences	▪ Gain basic knowledge about different research methodologies ▪ Learn to apply different systematic research and design processes in the area of architecture and engineering ▪ Gain skills in scientific working and scientific writing ▪ Gain advanced knowledge and skills about sustainable construction methods in building and facade design ▪ Earn competences in the evaluation of sustainable materials and constructions through life cycle assessment
Contents of Study	▪ The lectures provide an overview of different research methodologies, sustainable materials and constructions

	▪ Furthermore the basic principles of the evaluation methods are mediated and life cycle assessment methods are presented and discussed. ▪ In the accompanying exercises, the content of the lecture will be deepened by means of concrete models and calculation programs. ▪ One-semester assignment, which is to be presented in the exam, is practiced independently, where the students have to apply scientific methods to prepare a research paper in the broad field of sustainability
Forms of Exams	Elaboration and Colloquium
Literature	▪ Schulz, J.-U.: Theory and Sustainable Construction. Script ▪ Climate Emergency Design Guide. 2020. Leti.. https://www.leti.uk/cedg ▪ Coulson, J.: A Handbook for the Sustainable Use of Timber in Construction 2021 ▪ Figl, H. et al: ÖKOBAUDAT Basis for the building life cycle assessment 2nd Edition 2019 ▪ Gasparri, Eugenia et al.: Rethinking Building Skins, Elsevier, 2021 ▪ Gervasio, H.: Recommendations and guidelines to foster sustainable design. JRC 112809 2018 ▪ Gervasio, H.; Dimova, S.: Model for Life Cycle Assessment (LCA) of buildings. JRC 110082 2018 ▪ Goodhew, S.: Sustainable Construction Processes - A Resource Text 2016 ▪ Knaack, U. et al.: JFDE - Journal of Facade Design and Engineering, 2022, Online Ressource: https://www.jfde.eu/index.php/jfde/index ▪ Othman, D.; Arztmann, D.: Evaluating the environmental performance of stick curtain wall systems, Facade Tectonics Conference Proceedings, Façade Tectonics Institute, Los Angeles, 2022

Module Title	**Culture and Climate Related Facade Design**			
Module Number	**MID 2040**			
Module Responsibility	Prof. Dipl.-Ing. Daniel Arztmann			
Lecturer	Prof. Dipl.-Ing. Daniel Arztmann, Prof. Dr.-Ing. Winfried Heusler, wiss. Mitarbeiter, Lehrbeauftragte, Industry Experts, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module FD	x	Compulsory Module	
Semester	2			
Forms of Teaching	Lecture, seminar, workshop, excursion			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	2	Other	3
Workload (h)	Lecture	30	Laboratory	
	Seminar	15	Workshop	15
	Excursion	15	Work Experience	
	Self-Study	100	Exam Preparation	25
Workload total (h)	180			
Credits	6			
Prerequisites	Project and Modules of Semester 1			
Focus on the Sustainability Goals (17 UN SGDs)	▪ Good Health and Well-Being Building envelopes contribute to urban health and well-being as well as to a comfortable and healthy interior living on a large scale. ▪ Affordable and Clean Energy A well and careful designed, manufactured and installed façade has a huge impact on the operational and embodied energy consumption of a building. With the inclusion of photovoltaics and wind power it can be used for renewable energy production. ▪ Industry, Innovation and Infrastructure Considering local conditions and cultural characteristics in façade product and building design help to build a resilient infrastructure. Principles like design from / for recycling, the development of refurbishment and reuse strategies and the implementation of renewable energy concepts in the design of new products foster sustainable industrialization and innovation. ▪ Climate Action The reduction of operational and embodied energy consumption leads to an improved Co^2 foodprint of a building what helps to mitigate climate change. Furthermore, resilient building envelopes are designed to withstand changing			

	weather conditions and the direct impacts of the climate change like hurricanes, strong rains, hail, high temperatures.
Goal of study and Competences	▪ learn research methods to investigate climate conditions and cultural characteristics in different locations around the world ▪ gain knowledge about design and operating principles of traditional architecture ▪ specific understanding of construction technologies (fabrication, assembly and installation) for façade systems, designed for diverse climatic regions ▪ gain basic knowledge about project management, project design and planning with regard to ecological and economical aspects as well as regulations and standards ▪ handling and layout of details and constructional drafts and sections with CAD software-tools ▪ handling with 2D and 3D construction-tools to create fabrication and assembly plans
Contents of Study	▪ lectures about research methods to analyse building envelope requirements in different locations ▪ lectures about specific aspects of the design, detailing and production of sustainable façade constructions including climate and culture design, sustainable and resilient façade design, facades systems for changing locations and climates ▪ hands-on practical training on how to assemble a unitized façade mock-up. ▪ overview of current planning software with training and application in the course with special project exercises (e.g. SchüCal, SchüCad, Athena and other proprietary softwares)
Forms of Exams	Elaboration, presentation
Literature	▪ Scripts, company's records and documents at Ilias ▪ Ching, Francis D.K. (2020). Building Construction Illustrated, New Jersey: Wiley Verlag ▪ Compagno, Andrea (2002). Intelligent Glass Facades. Berlin: Birkhäuser ▪ Cremers Jan et al. (2016). Building Openings Construction Manual. Munich. DETAIL Verlag ▪ Hausladen, Gerhard et al. (2011). Building to Suit the Climate – A Handbook. Basel: Birkhäuser Verlag. ▪ Herzog, Thomas et al. (2021). Facade Construction Manual. Munich: DETAIL Verlag. ▪ Hindrichs, Dirk U. (2007). Plusminus 20°/40° latitude, Sustainable Building Design in Tropical and Subtropical regions, Stuttgart: Edition Axel Menges ▪ Knaack, Ulrich et al. (2012). Principles of Construction - Facades. Basel: Birkhäuser Verlag. ▪ Knaack, Ulrich et al. (2022). JFDE - Journal of Facade Design and Engineering, Online Ressource: https://www.jfde.eu/index.php/jfde/index ▪ Köhler, Manfred (2012), Handbuch Bauwerksbegrünung, Köln: Rudolg Müller Verlag ▪ Oesterle, Eberhard et al. (2001). Double-Skin Facades. Prestel Verlag ▪ Patterson, Mic (2011). Structural Glass Facades and Enclosures. Wiley.

	▪ Pfoser, Nicole et al. (2014), Gebäude, Begrünung, Energie, Bonn: FLL ▪ Pottgiesser, Uta (2004). Fassadenschichtungen Glas. Berlin: Bauwerk Verlag ▪ Rice, Peter et al. (1995). Transparente Architektur – Glasfassaden mit Structural Glazing, Basel : Birkhäuser Verlag ▪ Schröpfer, Thomas et al. (2011). Material Design – Informing Architecture by Materiality, Basel: Birkhäuser Verlag

Module Title	Digital Fabrication and Robots			
Module Number	MID 2050			
Module Responsibility	Prof. Hans Sachs, Prof.'in Andrea Kondziela			
Lecturer	Prof. Hans Sachs, Prof.'in Andrea Kondziela, Prof. Markus Schein, Dipl.-Ing. David Lemberski, Dipl.-Ing. Guido Brand, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module	x	Compulsory Module	
Semester	2			
Forms of Teaching	lectures, seminar, workshop			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	2	Other	3
Workload (h)	Lecture	30	Laboratory	
	Seminar	15	Workshop	30
	Excursion		Work Experience	
	Self-Study	90	Exam Preparation	35
Workload total (h)	180			
Credits	6			
Prerequisites	None			
Focus on the Sustainability Goals (17 UN SGDs)	The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. The Professorship of CAAD respectively to its activities in the Master of Integrated Design and the Master of Integrated Architectural Design sets a strong focus on a sustainable digital transformation in the building sector and especially integrates the following Sustainable Development Goals of the UN into its curriculum: ▪ Good Health and Well-Being In the built environment materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and well beeing. Here digital technologies provide a vast field of potential for the support of planning, building and controlling processes with accurate and widely data-based analysis, calculation, simulation and generation of architectural space. ▪ Affordable and Clean Energy A large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to have less negative impact on the world's climate. Thus planning and building must develop and integrate new energy and resource			

	efficient technologies, material efficiency and consciousness. As well it must support and protect natural ecosystems. Digital tools and methods can enable, trigger, integrate, calculate and support concepts with a focus on energy efficiency in architecture. ▪ Industry, Innovation and Infrastructure Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of the digital transformation in building construction needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ Sustainable Cities and Communities Large Cities will be the key drivers of developments for Intelligently and socially digitized, sustainable habitats in the future as they are the main polluters, energy consumers and hot spots for social inequality today. New concepts and rule-sets for a cohabitation of vegetation, humans, animals and robots need to be mindfully explored, tested and applied. ▪ Responsible Consumption and Production An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. In this intertwined system of a future digital production, use and consumption in the built environment new concepts for (digital) process chains need to be explored and developed. ▪ Climate Action Digital Tools (Software) and related Methods represent a comprehensive source for optimization, monitoring, documentation and control of architectural spaces as well as building components. When integrated and applied well, they have a large potential to reduce, reflect, detect and adjust climate-damaging effects in the building industry. They can have a positive impact through digital planning & fabrication, house automation (smart home) and digitized re-use and recycling processes. ▪ Partnership for the Goals The Digitalization of research networks enables global, faster and further reaching communication, documentation and (knowledge) exchange on the processes and goals mentioned above. The focus of the University lies on the development of more exchange in study programs, students, teaching staff, facilities and research activities, especially on initiatives on more sustainability.
Goal of study and Competences	▪ To demonstrate the influence and possibilities of changed production conditions through the use of computer-aided manufacturing processes. ▪ Understanding and ability to evaluate machine-based fabrication methods in architecture and related fields.

	▪ Teaching the basics and advanced knowledge of additive, subtractive and forming production methods, as well as their automation.
Contents of Study	▪ Overview of the most important additive, subtractive and transformative digital manufacturing technologies and their material categories ▪ Application of different digital fabrication methods based on practical examples and designs, e.g.: Transfer of digital 2D and 3D data to CAD-CAM capable production machines or generative rapid prototyping methods. ▪ The lecture introduces the different methods and analyzes them in a theoretical context. ▪ Outlook on future developments in the field of digital fabrication and adjacent production areas ▪ Excursions, company visits and trade fair visits complement the course content.
Forms of Exams	elaborations, presentations, oral examination, written examination
Literature	▪ Philip F. Yuan, Neil Leach, Achim Menges (2018). Digital Fabrication. Tongji University Press ▪ Gilles Retsin, Manuel Jimenez, Mollie Claypool, Vicente Soler (2019). Robotic Building: Architecture in the Age of Automation, DETAIL ▪ Iwamoto, L. (2009). Digital Fabrications. Architectural and Material Techniques, New York. ▪ Cache, B., & Speaks, M. (1995). Earth moves: the furnishing of territories. MIT Press. ▪ Sennett, R. (2009). The Craftsman. Yale University Press ▪ Dunn (2012). Digital Fabrication in Architecture. Laurence King ▪ Caneparo, L. (2014). Digital fabrication in architecture, engineering and construction. A. Cerrato (Ed.). Springer. ▪ Beorkrem, C. (2012). Material Strategies in Digital Fabrication. Routledge: 1st Edition ▪ Kolarevic, B. (2005). Architecture in the Digital Age: Design and Manufacturing. Taylor & Francis Ltd ▪ Sheil, B. (2005). Design through making: An introduction. Architectural Design, 75(4), 5-12. ▪ Sheil, B. (Ed.). (2012). Manufacturing the bespoke: making and prototyping architecture. John Wiley & Sons.

Module Title	Master Project Research & Practice			
Module Number	**MID 3000**			
Module Responsibility	Prof. Hans Sachs, Prof. Daniel Arztmann, Prof.'in Andrea Kondziela			
Lecturer	Prof. Hans Sachs, Prof. Daniel Arztmann, Prof.'in Andrea Kondziela, Prof. Markus Schein, Lehrbeauftragte, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module	x	Compulsory Module	
Semester	3			
Forms of Teaching	lectures, laboratory, excursion			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	1	Other	7
Workload (h)	Lecture	15	Laboratory	60
	Seminar		Workshop	
	Excursion	45	Work Experience	
	Self-Study	200	Exam Preparation	40
Workload total (h)	360			
Credits	12			
Prerequisites	Projects of 1. and 2. semester completed			
Focus on the Sustainability Goals (17 UN SGDs)	The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. The Professorship of CAAD respectively to its activities in the Master of Integrated Design and the Master of Integrated Architectural Design sets a strong focus on a sustainable digital transformation in the building sector and especially integrates the following Sustainable Development Goals of the UN into its curriculum: ▪ Good Health and Well-Being In the built environment materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and well beeing. Here digital technologies provide a vast field of potential for the support of planning, building and controlling processes with accurate and widely data-based analysis, calculation, simulation and generation of architectural space. ▪ Affordable and Clean Energy A large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to have less negative impact on the world's climate. Thus planning and			

	building must develop and integrate new energy and resource efficient technologies, material efficiency and consciousness. As well it must support and protect natural ecosystems. Digital tools and methods can enable, trigger, integrate, calculate and support concepts with a focus on energy efficiency in architecture. ▪ Industry, Innovation and Infrastructure Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of the digital transformation in building construction needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ Sustainable Cities and Communities Large Cities will be the key drivers of developments for Intelligently and socially digitized, sustainable habitats in the future as they are the main polluters, energy consumers and hot spots for social inequality today. New concepts and rule-sets for a cohabitation of vegetation, humans, animals and robots need to be mindfully explored, tested and applied. ▪ Responsible Consumption and Production An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. In this intertwined system of a future digital production, use and consumption in the built environment new concepts for (digital) process chains need to be explored and developed. ▪ Climate Action Digital Tools (Software) and related Methods represent a comprehensive source for optimization, monitoring, documentation and control of architectural spaces as well as building components. When integrated and applied well, they have a large potential to reduce, reflect, detect and adjust climate-damaging effects in the building industry. They can have a positive impact through digital planning & fabrication, house automation (smart home) and digitized re-use and recycling processes. ▪ Partnership for the Goals The Digitalization of research networks enables global, faster and further reaching communication, documentation and (knowledge) exchange on the processes and goals mentioned above. The focus of the University lies on the development of more exchange in study programs, students, teaching staff, facilities and research activities, especially on initiatives on more sustainability.

General goal of study and Competences	The ability to develop individual concepts for context driven architectural or engineering projects, using the theoretical knowledge and practical skills learned in the specialized, core modules and projects. The project can be a preparation project for the master thesis in order to deepen the knowledge and experience in the development of relevant research questions as well as the ability to communicate results in either scientific writing, an artistic study or an architectural / engineering concept. The project should be strongly connected with and accompanied by the elective module MID 302 and MID 303 “Conference and Communication” Specific goals: ▪ The ability to analyze judge and assess different contextual influences and situations to the benefit of a project. ▪ A profound understanding of the nature of structural, architectural and functional systems in existing buildings. ▪ The ability to present the conception of the project, both orally and on paper in a clear and appropriate way as well as critical reflection of what has been achieved ▪ The students will be qualified to develop independently strategies for learning and research. ▪ Through consultations between the concentrations, students will learn to work in office or research laboratory like situations and how to benefit from interdisciplinary approaches. In the teamwork assignments within the overall project, the student will develop conflict management and chair skills. ▪ The student should proof the ability to successfully develop a range of steps from analysis to design concept and definitive design for a factual architectural assignment.
Specific Goal of study and Competences – Computational Design	The overall focus lies on a comprehensive understanding of the use of computational design and production techniques in the analytical phase, the design development, communication and (re-) presentation and the digital (re-) production of the built environment ▪ Enhancement of a comprehensive knowledge about digital architectural design methods ▪ A profound understanding of algorithm-based or AI (Machine-, Deep Learning) planning tools, techniques and strategies in the context of architectural design processes. ▪ The capability to apply, modify and interconnect tools for generative modeling and digital fabrication. ▪ General knowledge and experience in the harmonization of design and construction requirement and development processes through the use of digital tools and the implementation of process-oriented planning methods

Specific Goal of study and Competences – Facade Design	The overall focus lies on a comprehensive understanding of up-to-date façade design and construction technologies with considering all steps in the product life cycle and the influence of the building envelope on the built environment. ▪ Enhancement of a comprehensive knowledge about professional façade design and construction technologies ▪ A profound understanding of the technological and physical principles of the building envelope and its influence on different building performance criteria ▪ The capability to apply, modify and interconnect digital tools for the analysis and simulation of building facades in its different development stages. ▪ General knowledge and experience in the harmonization of design and construction requirement and development processes through the use of digital tools and the implementation of process-oriented planning methods
Contents of Study	▪ The design studio is the focal point of the third semester. It centers on a building design in a historical context (Reuse / Extension / New). Methods for analysing the building fabric and its economical, technical and cultural assessments are integrated in the overall design process. ▪ The documentation of the project shows the design as well as the design process. ▪ Materials and details are considered in relevant scales ▪ An accompanying lecture series will illustrate the effect of contextual influences of diverse scales and natures, on the design and design process of architectural projects, show the history and development systems and technologies, climate adapted building design and the history of architectural planning methods (hand drawing, CAAD, generative algorithms, BIM). ▪ Mastering theory and architectural applications of complex geometries and building performance. ▪ A comprehensive integration of contextual data into digital modeling processes. ▪ The use of computational tools to extend and (re-) interpretate design techniques in the process of architectural design and development in example in the survey, operation and deconstruction phase of an architectural project. ▪ A comprehensive integration of computation–based bottom-up strategies in example by using user- or data generated, material-based or physics-driven modeling techniques ▪ The application of computational tools, techniques and methods in re-use design, refurbishment and building design and construction in historic architectural context
Forms of Exams	Mid-term and final presentation, submission of an architectural presentation, scientific article(s)
Literature	▪ Digital media and scripts at the E-learning platform ▪ Bullen, P., Love, P. 2011, 'Factors influencing the adaptive re-use of buildings', Journal of Engineering, Design and Technology Vol. 9 No. 1, pp. 32–46

	▪ van Uffelen, Chris (2010). Re-Use Architecture, Braun Publishing ▪ Pettinari, J. 1980, 'Adaptive Reuse: A Case Study', Journal of Interior Design and Research, Vol. 6, No. 2, pp. 33–42 ▪ Pfammatter, Ulrich (2014). Building for a Changing Culture and Climate. Berlin: Dom Publishers, Berlin. ▪ Preservation Green Lab (2012). The Greenest Building: Quantifying the Environmental Value of Building Reuse ▪ Rabun, J. Stanley and Kelso, Richard (2009). Building Evaluation for Adaptive Reuse and Preservation, Hoboken: John Wiley & Sons, Inc., ▪ BUILT TO LAST. The Sustainable Reuse of Buildings. An Action of the Dublin City Heritage Plan (2004). Dublin City. The Heritage Council. ▪ Michael U. Hensel (Editor) on (2012). Design Innovation for the Built Environment: Research by Design and the Renovation of Practice. Routledge publishers New York ▪ Emergence: The Connected Lives of Ants, Brains, Cities and Software (2002),Steven Johnson ▪ Aesthetics of Sustainable Architecture (2013), Sang Lee ▪ Site Analysis: A Contextual Approach to Sustainable Land Planning and Site Design (2007) James A. LaGro ▪ Experimental Green Strategies: Redefining Ecological Design Research (Architectural Design),(2011), Terri Peters (Editor) ▪ Protocell Architecture: Architectural Design :81 (2011), Neill Spiller, Rachel Armstrong ▪ Contextual Design: Defining Customer-Centered Systems (Interactive Technologies), Hugh Beyer, Karen Holtzblatt ▪ The Architecture of Emergence: The Evolution of Form in Nature and Civilisation (2010), Michael Weinstock ▪ Emergent Technologies and Design: Towards a Biological Paradigm for Architecture (2010) Michael Hensel, Achim Menges, Michael Weinstock ▪ Interdisciplinary Design: New Lessons from Architecture and Engineering (2012),Hanif Kara, Andreas Georgoulias ▪ Architectural Design Vol. 82 Material Computation (2012) Achim Menges (editor) ▪ Cremers Jan et al. (2016). Building Openings Construction Manual. Munich. DETAIL Verlag ▪ Hausladen, Gerhard et al. (2011). Building to Suit the Climate – A Handbook. Basel: Birkhäuser Verlag. ▪ Herzog, Thomas et al. (2021). Facade Construction Manual. Munich: DETAIL Verlag. ▪ Hindrichs, Dirk U. (2007). Plusminus 20°/40° latitude, Sustainable Building Design in Tropical and Subtropical regions, Stuttgart: Edition Axel Menges ▪ Knaack, Ulrich et al. (2012). Principles of Construction - Facades. Basel: Birkhäuser Verlag. ▪ Knaack, Ulrich et al. (2022). JFDE - Journal of Facade Design and Engineering, Online Ressource: https://www.jfde.eu/index.php/jfde/index ▪ Oesterle, Eberhard et al. (2001). Double-Skin Facades. Prestel Verlag ▪ Patterson, Mic (2011). Structural Glass Facades and Enclosures. Wiley.

	▪ Pfoser, Nicole et al. (2014), Gebäude, Begrünung, Energie, Bonn: FLL ▪ Rice, Peter et al. (1995). Transparente Architektur – Glasfassaden mit Structural Glazing, Basel : Birkhäuser Verlag ▪ Schröpfer, Thomas et al. (2011). Material Design – Informing Architecture by Materiality, Basel: Birkhäuser Verlag

Module Title	Open Elective Module			
Module Number	**MID 3010**			
Module Responsibility	Prof. Hans Sachs, Prof. Daniel Arztmann, Prof.'in Andrea Kondziela			
Lecturer	Prof. Hans Sachs, Prof. Daniel Arztmann, Prof.'in Andrea Kondziela, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module	x	Compulsory Module	
Semester	3			
Forms of Teaching	lectures, seminar, workshop, excursion			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	1	Other	6
Workload (h)	Lecture	15	Laboratory	
	Seminar	30	Workshop	30
	Excursion	30	Work Experience	
	Self-Study	60	Exam Preparation	15
Workload total (h)	180			
Credits	6			
Prerequisites	Projects of 1. and 2. semester completed			
Focus on the Sustainability Goals (17 UN SGDs)	The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. The Professorship of CAAD respectively to its activities in the Master of Integrated Design and the Master of Integrated Architectural Design sets a strong focus on a sustainable digital transformation in the building sector and especially integrates the following Sustainable Development Goals of the UN into its curriculum: ▪ Good Health and Well-Being In the built environment materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and well beeing. Here digital technologies provide a vast field of potential for the support of planning, building and controlling processes with accurate and widely data-based analysis, calculation, simulation and generation of architectural space. ▪ Affordable and Clean Energy A large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to have less negative impact on the world's climate. Thus planning and			

	building must develop and integrate new energy and resource efficient technologies, material efficiency and consciousness. As well it must support and protect natural ecosystems. Digital tools and methods can enable, trigger, integrate, calculate and support concepts with a focus on energy efficiency in architecture. ▪ Industry, Innovation and Infrastructure Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of the digital transformation in building construction needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ Sustainable Cities and Communities Large Cities will be the key drivers of developments for Intelligently and socially digitized, sustainable habitats in the future as they are the main polluters, energy consumers and hot spots for social inequality today. New concepts and rule-sets for a cohabitation of vegetation, humans, animals and robots need to be mindfully explored, tested and applied. ▪ Responsible Consumption and Production An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. In this intertwined system of a future digital production, use and consumption in the built environment new concepts for (digital) process chains need to be explored and developed. ▪ Climate Action Digital Tools (Software) and related Methods represent a comprehensive source for optimization, monitoring, documentation and control of architectural spaces as well as building components. When integrated and applied well, they have a large potential to reduce, reflect, detect and adjust climate-damaging effects in the building industry. They can have a positive impact through digital planning & fabrication, house automation (smart home) and digitized re-use and recycling processes. ▪ Partnership for the Goals The Digitalization of research networks enables global, faster and further reaching communication, documentation and (knowledge) exchange on the processes and goals mentioned above. The focus of the University lies on the development of more exchange in study programs, students, teaching staff, facilities and research activities, especially on initiatives on more sustainability.
Contents of Study	Accompanying input from self-selected modules inside and outside the TH-OWL. The Content and study goals should be strongly related to the MID 300 Master Project Research & Practice
Forms of Exams	Elaboration and Colloquium

Literature	▪ Papers on digital media (CD-ROM / Internet / e-learning) ▪ Company's records and documents ▪ Further literature depending on the specific focus

Module Title	**Conference and Communication**			
Module Number	**MID 3020**			
Module Responsibility	Prof. Dr.-Ing. Uta Pottgiesser			
Lecturer	Prof. Dr.-Ing. Uta Pottgiesser, wiss. Mitarbeiter M.A. Anica Dragutinovic, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module FD	x	Compulsory Module	
Semester	3			
Forms of Teaching	Seminar, workshop, excursion			
Language of Teaching	English			
Hours per Week (SWS)	Lecture		Other	3
Workload (h)	Lecture		Laboratory	
	Seminar	15	Workshop	15
	Excursion	15	Work Experience	
	Self-Study	100	Exam Preparation	35
Workload total (h)	180			
Credits	6			
Prerequisites	Modules of semester 1 + 2			
Focus on the Sustainability Goals (17 UN SGDs)	▪ SDG 4 Quality Education (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all) The different ways of dissemination address diverse target audience in form of an Open Access publication ▪ SDG11 Sustainable Cities and Communities (Make cities and human settlements inclusive, safe, resilient and sustainable) Dealing with existing buildings and sites and reflecting on their conservation, rehabilitation and re-use has a huge impact on the operational and embodied energy consumption of a building, neighborhood or a city and improves the carbon footprint of the environment. ▪ SDG 12 Responsible Consumption and Production (Ensure sustainable consumption and production patterns) Considering local conditions and cultural characteristics in conservation, building and product design helps to save resources through principles like design from / for recycling, the development of refurbishment and reuse strategies.			
Goal of study and Competences	▪ gain advanced knowledge of academic and scientific networking in the construction sector,			

	▪ apply the knowledge of Module C4 to produce a scientific output in a digital application, ▪ reflect the “State of the Art” and new developments of research, design and technology in the chosen topic, ▪ categorise, restructure and document the information and results from previous research and projects, ▪ gain detailed knowledge of digital tools and forms of dissemination of research results (e. g. websites, Apps, Simulations, Videos, 3D Models, AR, VR) ▪ adapt the methods to specific themes of a national or international conference of the academic network (preferably Docomomo Germany and International, European Façade Network and others), ▪ present their contribution (exhibit) and discuss the results with the audience and experts. ▪ summarize the process and results in a digital documentation that will be published Open Access.
Contents of Study	▪ individual research provides an up-to-date overview of current national and international activities and scientific conferences in the field of architecture and design, ▪ supplementing the Core and Specialised Modules, ▪ seminars deal with presentations and peer review of the different steps of productions related to content, analysis and presentation of results ▪ a workshop deals with the conception of the conference presentation of all results in form of an exhibition, models, posters or other formats ▪ an excursion usually connects the students with the conference theme, relevant topics and objects and with the conference location
Forms of Exams	Elaboration, presentation
Literature	▪ Scripts, company’s records and documents at ILIAS: ▪ Proceedings of visited and other conferences and scientific papers from research platforms ▪ Bendix, Manuela (2008). Wissenschaftliches Arbeiten ▪ typografisch gestalten. Berlin, Heidelberg: Springer-Verlag. Campuszugriff: http://dx.doi.org/10.1007/978-3-540-73392-8. ▪ Clark, Roy Peter (2006). Writing Tools: 50 Essential Strategies for Every Writer. (pdf) URL: https://dcripe.files.wordpress.com/2014/06/50-writing-tools.pdf ▪ Flick, U. u.a. (Hrsg.) (1991): Handbuch Qualitative ▪ Sozialforschung. München. ▪ Forty, Adrian (2000). Words and Buildings: A Vocabulary of Modern Architecture. (pdf) URL: http://morfologia.arch.duth.gr/4o_etos/4o_exam_VIII/wb_form.pdf ▪ Gockel, Tilo (2010). Form der wissenschaftlichen ▪ Ausarbeitung. Studienarbeit, Diplomarbeit, Dissertation, ▪ Konferenzbeitrag. Berlin, Heidelberg: Springer-Verlag. ▪ Campuszugriff: http://dx.doi.org/10.1007/978-3-642-13907-9 ▪ Pottgiesser U, Dragutinovic A, Loddo M, & OWL University of Applied Sciences (Eds.). (2021). MoMove Modern Movement and Infrastructure. Technische Hochschule Ostwestfalen-Lippe. doi:10.25644/3m9j-0f94

	▪ Pottgiesser, U., Dragutinovic, A., & OWL University of Applied Sciences (Eds.). (2022). MoMove Modern Movement and Industrial Heritage. Lemgo: Technische Hochschule Ostwestfalen-Lippe. Doi: https://doi.org/10.25644/4d3d-2v96 ▪ Singh, Yogesh Kumar (2014). Fundamental of Research ▪ Methodology and Statistics. New Dehli: New Age International. ▪ Steffen, Dagmar (2014). New experimentalism in design ▪ research. Characteristics and interferences of experi-ments in science, the arts, and in design research. In: Artifact III (2), pp 1.1-1.16. ▪ Turabian, Kate L. A (2010). Manual for Writers of Research Papers, Theses, and Dissertations: Chicago Style for Students and Researchers (8th ed.). URL: https://pendbingikgs.files.wordpress.com/2016/12/a-manual-for-writers.pdf

Module Title	**Materials, Surfaces and Security**			
Module Number	**MID 3030**			
Module Responsibility	Prof. Dr.-Ing. Winfried Heusler			
Lecturer	Prof. Dr.-Ing. Winfried Heusler, Prof. Dipl.-Ing. Daniel Arztmann, wiss. Mitarbeiter, Lehrbeauftragte, Industry Experts, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module FD	x	Compulsory Module	
Semester	3			
Forms of Teaching	Lecture, seminar, workshop			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	2	Other	3
Workload (h)	Lecture	30	Laboratory	15
	Seminar	15	Workshop	
	Excursion	15	Work Experience	
	Self-Study	100	Exam Preparation	25
Workload total (h)	180			
Credits	6			
Prerequisites	Modules of semester 1 + 2			
Focus on the Sustainability Goals (17 UN SGDs)	▪ Good Health and Well-Being Building envelopes contribute to urban health and well-being as well as to a comfortable and healthy interior living on a large scale. ▪ Affordable and Clean Energy A well and careful designed, manufactured and installed façade has a huge impact on the operational and embodied energy consumption of a building. With the inclusion of photovoltaics and wind power it can be used for renewable energy production. ▪ Industry, Innovation and Infrastructure Considering local conditions and cultural characteristics in façade product and building design help to build a resilient infrastructure. Principles like design from / for recycling, the development of refurbishment and reuse strategies and the implementation of renewable energy concepts in the design of new products foster sustainable industrialization and innovation. ▪ Climate Action The reduction of operational and embodied energy consumption leads to an improved Co² foodprint of a building what helps to mitigate climate change. Furthermore, resilient building envelopes are designed to withstand changing			

	weather conditions and the direct impacts of the climate change like hurricanes, strong rains, hail, high temperatures.
Goal of study and Competences	▪ gain advanced knowledge of specific requirements and solutions for facades and their components. ▪ gain detailed knowledge of glass (historical and current types, products, standards and regulations) ▪ gain detailed knowledge of metal (historical and current types, products, standards and regulations) ▪ gain detailed knowledge of façade systems for specific requirements regarding functional security (fire and smoke protection, burglar, bullet, blast and earthquake resistance) ▪ gain detailed knowledge on surface treatments (technologies, standards and regulations) ▪ gain knowledge about daylighting systems (principles, products and standards), ▪ present and discuss the results in the plenum.
Contents of Study	▪ lectures on specific aspects of facades (e. g. combination of materials, finishes and coatings; combination of energetic, thermal, acoustic and structural requirements; combination of security requirements; combination of daylighting and sun-shading requirements), ▪ lectures deal with: legal requirements, detail aspects, comfort interaction with the facade, integration of technical equipment (e. g. sensors and motors) into the facade
Forms of Exams	Elaboration, presentation
Literature	▪ Scripts, company's records and documents at Ilias ▪ Ching, Francis D.K. (2020). Building Construction Illustrated, New Jersey: Wiley Verlag ▪ Compagno, Andrea (2002). Intelligent Glass Facades. Berlin: Birkhäuser ▪ Cremers Jan et al. (2016). Building Openings Construction Manual. Munich. DETAIL Verlag ▪ Hausladen, Gerhard et al. (2011). Building to Suit the Climate – A Handbook. Basel: Birkhäuser Verlag. ▪ Herzog, Thomas et al. (2021). Facade Construction Manual. Munich: DETAIL Verlag. ▪ Hindrichs, Dirk U. (2007). Plusminus 20°/40° latitude, Sustainable Building Design in Tropical and Subtropical regions, Stuttgart: Edition Axel Menges ▪ Knaack, Ulrich et al. (2012). Principles of Construction - Facades. Basel: Birkhäuser Verlag. ▪ Knaack, Ulrich et al. (2022). JFDE - Journal of Facade Design and Engineering, Online Ressource: https://www.jfde.eu/index.php/jfde/index ▪ Köhler, Manfred (2012), Handbuch Bauwerksbegrünung, Köln: Rudolg Müller Verlag ▪ Oesterle, Eberhard et al. (2001). Double-Skin Facades. Prestel Verlag ▪ Patterson, Mic (2011). Structural Glass Facades and Enclosures. Wiley. ▪ Pfoser, Nicole et al. (2014), Gebäude, Begrünung, Energie, Bonn: FLL

	▪ Pottgiesser, Uta (2004). Fassadenschichtungen Glas. Berlin: Bauwerk Verlag ▪ Rice, Peter et al. (1995). Transparente Architektur – Glasfassaden mit Structural Glazing, Basel : Birkhäuser Verlag ▪ Schröpfer, Thomas et al. (2011). Material Design – Informing Architecture by Materiality, Basel: Birkhäuser Verlag

Module Title	Computational Optimization			
Module Number	**MID 3040**			
Module Responsibility	Prof. Dipl.-Ing. Jens-Uwe Schulz			
Lecturer	Prof. Dipl.-Ing. Jens-Uwe Schulz, N.N.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module C	x	Compulsory Module	
Semester	3			
Forms of Teaching	Lecture and exercise, seminar			
Language of Teaching	English			
Hours per Week (SWS)	Lecture	2	Other	2
Workload (h)	Lecture	30	Laboratory	
	Seminar	30	Workshop	
	Excursion		Work Experience	
	Self-Study	80	Exam Preparation	40
Workload total (h)	180			
Credits	6			
Prerequisites	Digital Tools & Methods I (C1), Programming and Simulation (S7), Construction and Dimensioning (C2)			
Focus on the Sustainability Goals (17 UN SGDs)	▪ **Ensure healthy lives and promote well-being for all at all ages (Goal 3)** Architecture and the built environment directly affect our health and well-being on various scales. Materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and emotions. In this context the dimensioning of Constructions can support with accurate and widely data-based analysis, calculation, simulation and generation of architectural space with a strong focus on sustainable solutions. ▪ **Ensure access to affordable, reliable, sustainable and modern energy for all (Goal 7)** A dominantly large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to become more climate friendly. Therefor architecture must develop and integrate new energy and resource efficient technologies, material consciousness and support natural ecosystems. Computational Optimization methods are capable to enable, trigger, integrate and support new energy concepts in architecture. ▪ **Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (Goal 9)**			

	Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of new developments in (industrial) building construction needs Computational Optimization methods to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ **Ensure sustainable consumption and production patterns (Goal 12)** An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. Construction design and Production are intertwined ▪ **Take urgent action to combat climate change and its impacts (Goal 13)** A well structural design can help to reduce primary energy consumption. ▪ **Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Developmen (Goal 17)** Sustainable building uses the strength of networks and international partnerships to develop common solutions and to implement them in concrete terms.
Goal of study and Competences	• Facilitate the capabilities to identifying and describing a problem • Foundation of different optimization methods and its area of operation • Identification of a suitable optimization process for a given problem • Integration of optimization algorithms in a planning process • Competence to judge the computed results
Contents of Study	• The study of optimization integrates design and structural decisions, to create optimal solutions within set parameters. • These solutions are often structural: and aim to reduce the amount material, span further, and leverage structural latencies. Optimization can also be applied to building program, function and form. The two leading domains of optimization are: shape optimization and topological optimization. Both forms of optimization attempt to reach an optimal solution with respect to a set of parameters that define a fitness function. • Both approaches share the same procedural logic: an initial geometry is defined; boundary conditions are defined that control the optimization; definition of one or more fitness functions. • Even though the fundamental process is the same for both of these techniques, there are conceptual and algorithmic differences. • This module will give you theoretically understanding of how optimization algorithms are working and how they are applicable for solving architectural and structural problems. • Students will solve individually defined optimization problems
Forms of Exams	Elaboration and Colloquium
Literature	• Schulz, J.-U.: Computational Optimization. Script

	• Arora, J. S.: Introduction to Optimum Design. 4th-Edition, Elevier, 2017 • Belegundu, A. D.; ChandrupatlaT. R.: Optimization Concepts and Applications in Engineering. 3rd Edition, Cambridge Universty Press, 2019 • Christensen, P. W.; Klarbring, A.: An Introduction to Structural Optimization. Springer, 2009 • Johansson, R.: Numerical Python - A Practical Techniques Approach for Industry. Apress, 2nd Edition, 2019 • Rao, S. S.: Engineering Optimization Theory and Practice. 5th Edition, John Wiley & Sons, 2020 • Vanderplaats, G. N.: Numerical Optimization for Engineering. 3^{rd} Edition 1999

Module Title	Masterthesis			
Module Number	**MID 4000**			
Module Responsibility	All professors			
Lecturer	from the course, all external lecturers from external partners can act as supervisors for the thesis.			
Course of Study	Master Integrated Design (MID)			
Status	Mandatory Module	x	Compulsory Module	
Semester	4			
Forms of Teaching	Self-organized final project for the master course			
Language of Teaching	English			
Hours per Week (SWS)	Lecture		Other	
Workload (h)	Lecture		Laboratory	
	Seminar		Workshop	
	Excursion		Work Experience	
	Self-Study	850	Exam Preparation	50
Workload total (h)	900			
Credits	30			
Prerequisites	All Modules of the master course			
Focus on the Sustainability Goals (17 UN SGDs)	The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. The Professorship of CAAD respectively to its activities in the Master of Integrated Design and the Master of Integrated Architectural Design sets a strong focus on a sustainable digital transformation in the building sector and especially integrates the following Sustainable Development Goals of the UN into its curriculum: ▪ Good Health and Well-Being In the built environment materials, energy, spatial configuration, navigation, infrastructure and further aspects do have a significant impact on our health, (social) behavior and well beeing. Here digital technologies provide a vast field of potential for the support of planning, building and controlling processes with accurate and widely data-based analysis, calculation, simulation and generation of architectural space. ▪ Affordable and Clean Energy A large part of the overall energy and resource consumption in the world is related to the built environment. Processes as planning, construction, use, restoration, deconstruction and recycling are considered to have a huge potential to have less negative impact on the world's climate. Thus planning and building must develop and integrate new energy and resource			

	efficient technologies, material efficiency and consciousness. As well it must support and protect natural ecosystems. Digital tools and methods can enable, trigger, integrate, calculate and support concepts with a focus on energy efficiency in architecture. ▪ Industry, Innovation and Infrastructure Industry, innovation and available infrastructure play a central role in the realization of architectural projects. The focus of the digital transformation in building construction needs to be on natural, recyclable, reusable, energy saving systems as well as new, smart and eco-friendly materials and processes. ▪ Sustainable Cities and Communities Large Cities will be the key drivers of developments for Intelligently and socially digitized, sustainable habitats in the future as they are the main polluters, energy consumers and hot spots for social inequality today. New concepts and rule-sets for a cohabitation of vegetation, humans, animals and robots need to be mindfully explored, tested and applied. ▪ Responsible Consumption and Production An integrative, well planned built environment can trigger and support social progression towards a thoughtful association with our natural resources and spaces. In this intertwined system of a future digital production, use and consumption in the built environment new concepts for (digital) process chains need to be explored and developed. ▪ Climate Action Digital Tools (Software) and related Methods represent a comprehensive source for optimization, monitoring, documentation and control of architectural spaces as well as building components. When integrated and applied well, they have a large potential to reduce, reflect, detect and adjust climate-damaging effects in the building industry. They can have a positive impact through digital planning & fabrication, house automation (smart home) and digitized re-use and recycling processes. ▪ Partnership for the Goals The Digitalization of research networks enables global, faster and further reaching communication, documentation and (knowledge) exchange on the processes and goals mentioned above. The focus of the University lies on the development of more exchange in study programs, students, teaching staff, facilities and research activities, especially on initiatives on more sustainability.
Goal of study and Competences	▪ finalising the course of studies in a holistic interdisciplinary approach to practise facade or computational design a an expert / specialist ▪ Production and documentation of independent solutions to complex problems related to computational or façade design using scientific knowledge and methods within a prescribed deadline.

	▪ Understanding of in-depth and skilled scientific knowledge and approaches relating to design and construction of a technical and methodological nature. ▪ produce responsible solutions to complex problems both in practice and in research and development in a scientific manner using skilled design, construction, technical and methodological knowledge and abilities.
Contents of Study	▪ participants obtain list of topics that are offered by the docents, ▪ own topics can be chosen after coordinating with the board of examination and the first supervisor, ▪ specific topics can be chosen in cooperation with external and industry partners, ▪ the master thesis normally consists of an independent task with a methodological, technical-constructional or organisational assignment, ▪ depending on the type of assignment, a draft, a model, a piece of work or a written or digital composition should be prepared, ▪ the master thesis may also be a theoretical work with specialist content.
Forms of Exams	Elaboration with presentation and colloquium
Literature	▪ Papers on digital media (CD-ROM / Internet / e-learning), ▪ Company's records and documents ▪ Literature depending on the topic