Competence coverage matrix

GHENT UNIVERSITY

International Master of Science in Fire Safety Engineering

Academic year 2021-2022

Legend:
T=teaching methods
E=evaluation methods

			General Courses																										Master's Dissertation
			E051540 Explosions and Industrial Fire Safety	E061522 Performance-Based Design	E051430 Fire Dynamics	E051581 Fire Research Seminar	E039161 Thermodynamics, Heat and Mass Transfer	E051570 Material Behaviour at Ambient and Elevated Temperatures	E051482 Active Fire Protection I: Detection and Suppression	E051494 Active Fire Protection II: Smoke and Heat Control	E051443 Fire Safety and Legislation	E051610 Passive Fire Protection	E900527 Fire Science and Fire Dynamics	E900529 Fire Safety Engineering	E900530 Research Methods for Engineers	E900528 Structural Mechanics	E900524 Finite Element Analysis for Solids	E900531 Fire Science Laboratory	E900532 Fire Investigation and Failure Analysis	E900522 Structural Design for Fire	E900533 Fire Safety, Engineering and Society	E900304 Risk Assessment	E900305 Advanced Fire Dynamics	E900306 Human Behaviour in Fire	E900525 Simulation of Fires in Enclosures	E091105 Master's Dissertation
Competences in one/more scientific discipline(s)	Master and apply advanced knowledge in the own engineering discipline in solving complex problems.	T 14 E 14	T E	T E			T E		T E	T E		T E						T E	T E	T E		T E	T E	T E	T E	T E
	Apply Computer Aided Engineering (CAE) tools and advanced communication instruments in a creative and purposeful way.	T 7 E 7		T E						T E										T E		T E	T E	T E	T E	
	Master and apply knowledge of physics, chemistry, thermodynamics, heat and mass transfer to critically analyse and evaluate the development of fires in enclosures.	T 9 E 9		T E	T E		T E	T E											T E	T E	T E					T E	T E
	Master and apply knowledge of element methods and dynamics of structures to critically analyse and evaluate the behaviour of simple structures in case of fire.	T 3 E 3		T E																	T E						T E
	Master and apply knowledge of explosions to critically analyse and evaluate the associated risk.	T 4 E 4	T E	T E																T E							T E
	Master and apply the advanced knowledge of fire dynamics, risk assessment, human behaviour and integrate this to develop a performance based fire safety design.	T 7 E 7		T E	T E								T E						T E	T E	T E						T E
Scientific competences	Analyse complex problems and translate them into concrete research questions.	T 15 E 15	T E	T E		T E	T E		T E	T E		T E	T E						T E	T E		T E	T E	T E	T E	T E
	Consult the scientific literature as part of the own research.	T 8 E 7		T E		T E													T E	T E		T E		T E	T	T E
	Select and apply the appropriate models, methods and techniques.	T 15 E 15	T E	T E		T E		T E	T E	T E			T E					T E	T E	T E		T E	T E	T E	T E	T E
	Develop and validate mathematical models and methods.	T 3 E 3		T E																			T E			T E
	Interpret research findings in an objective and critical manner.	T 10 E 10		T E		T E				T E			T E						T E	T E		T E	T E	T E		T E
	Elaborate problems of fire risk assessment in a critical, autonomous and flexible manner with a limited amount of data.	T 7 E 7	T E	T E														T E	T E	T E		T E				T E
	Perform valid computer simulations of development and consequences of enclosure fires.	T 4 E 4		T E						T E															T E	T E
Intellectual competences	Independently form an opinion on complex situations and problems, and defend this point of view.	T 12 E 11	T E	T E		T E	T E		T E	T E									T E	T E		T E		T E	T	T E
	Apply knowledge in a creative, purposeful and innovative way to research, conceptual design and production.	T 9 E 8	T E	T E					T E	T E			T E						T E					T E	T	T E
	Critically reflect on one's own way of thinking and acting, and understand the limits of one's competences.	T 12 E 12	T E	T E					T E	T E								T E	T E	T E		T E	T E	T E	T E	T E
	Stay uptodate with the evolutions in the discipline to elevate the own competences to expert level.	T 12 E 11	T E	T E					T E		T E							T E	T E	T E		T E	T E	T E	T	T E
	Readily adapt to changing professional circumstances.	T 5 E 4	T E	T E														T E				T E			T	
	Develop scientifically sound arguments to optimize passive and active fire protection measures.	T 8 E 7		T E				T E	T E	T E		T E						T E							T	T E
Competences in cooperation and communication	Have the ability to communicate in English about the own field of specialisation.	T 13 E 13	T E	T E	T E	T E			T E	T E									T E	T E		T E	T E	T E	T E	T E
	Project management: have the ability to formulate objectives, report efficiently, keep track of targets, follow the progress of the project,...	T 12 E 11		T E		T E			T E	T E								T E	T E	T E		T E	T E	T E	T	T E
	Have the ability to work as a member of a team in a multi disciplinary workingenvironment, as well as being capable of taking on supervisory responsibilities.	T 8 E 7		T E					T E	T E								T E	T E			T E		T E	T	
	Report on technical or scientific subjects verbally, in writing and using graphics.	T 11 E 10		T E		T E			T E	T E								T E	T E			T E	T E	T E	T	T E
	Function in an international environment (students, PhD students, scientific co-workers, scholars).	T 8 E 7		T E		T E				T E								T E	T E	T E					T	T E
Societal competences	Act in an ethical, professional and social way.	T 11 E 11	T E	T E					T E	T E								T E	T E	T E		T E	T E	T E	T	E
	Recognize the most important business and legal aspects of the own engineering discipline.	T 4 E 4	T E	T E						T E									T E							
	Understand the historical evolution of the own engineering discipline and its social relevance.	T 6 E 6		T E									T E						T E	T E		T E		T E		
	Master and apply critical insight in existing fire safety legislation and regulations in the development of a fire safety design.	T 5 E 5	T E	T E						T E	T E																T E
	Act in an ethical, professional and social way when developing and presenting a performance based fire safety design.	T 5 E 4		T E						T E										T E						T	T E
Profession-specific competence	Master the complexity of technical systems by using system and process models.	T 5 E 5	T E	T E						T E												T E					T E
	Reconcile conflicting specifications and prior conditions in a high quality and innovative concept or process.	T 8 E 7	T E	T E					T E											T E			T E	T E	T	T E
	Synthesize incomplete, contradictory or redundant data into useful information.	T 12 E 11	T E	T E		T E			T E	T E								T E		T E		T E	T E	T E	T	T E
	Possess sufficient ready knowledge and understanding to evaluate the results of complex calculations, or make approximate estimates.	T 10 E 10	T E	T E					T E	T E									T E	T E		T E	T E	T E	T E	
	Pay attention to entire life cycles of systems, machines, and processes.	T 4 E 4	T E	T E					T E															T E		

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			E051540 Explosions and Industrial Fire Safety	E061522 Performance-Based Design	E051430 Fire Dynamics	E051581 Fire Research Seminar	E039161 Thermodynamics, Heat and Mass Transfer	E051570 Material Behaviour at Ambient and Elevated Temperatures	E051482 Active Fire Protection I: Detection and Suppression	E051494 Active Fire Protection II: Smoke and Heat Control	E051443 Fire Safety and Legislation	E051610 Passive Fire Protection	E900527 Fire Science and Fire Dynamics	E900529 Fire Safety Engineering	E900530 Research Methods for Engineers	E900528 Structural Mechanics	E900524 Finite Element Analysis for Solids	E900531 Fire Science Laboratory	E900532 Fire Investigation and Failure Analysis	E900522 Structural Design for Fire	E900533 Fire Safety, Engineering and Society	E900304 Risk Assessment	E900305 Advanced Fire Dynamics	E900306 Human Behaviour in Fire	E900525 Simulation of Fires in Enclosures	E091105 Master's Dissertation
Profession-specific competence	Pay attention to sustainability, energyefficiency, environmental cost, use of raw materials and labour costs.	T 4		T								T							T							
		E 4		E								E							E							
	Pay attention to all aspects of reliability, safety, and ergonomics.	T 7		T					T										T	T		T		T	T	
		E 7		E					E										E	E		E		E	E	
	Have insight into and understanding of the importance of entrepreneurship.	T 2		T																			T			
		E 2		E																			E			
	Show perseverance, innovativeness, and an aptitude for creating added value.	T 5		T					T	T											T					T
		E 5		E					E	E											E					E
			W 19 E 19	W 38 E 38	W 3 E 3	W 10 E 10	W 4 E 4	W 3 E 3	W 19 E 19	W 23 E 23	W 2 E 2	W 4 E 4	W 6 E 6					W 16 E 16	W 23 E 23	W 25 E 25		W 21 E 21	W 16 E 16	W 21 E 21	W 24 E 10	W 27 E 28

<< EMingwALG1.1 Master and apply advanced knowledge in the own engineering discipline in solving complex problems. *Competences in one/more scientific discipline(s)*

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	written examination with open questions report assignment participation	Knowledge: Master and apply the advanced knowledge of previous courses by integrating the fire protection techniques into a global risk performance based design. Knowledge: Use functional criteria (performance) as a criterion in order to realise and evaluate an original fire safety design. Knowledge: Evaluate self-reliantly the fire risk in a project. Skills: Analyse own results and results of others within fire performance based designs in an objective manner.
E039161 Thermodynamics, Heat and Mass Transfer	lecture seminar: coached exercises	written examination oral examination	Understand and calculate the consequences of heat transfer in case of fire. Quantify thermodynamic properties of pure substances and mixtures. Solve a new complex problem, involving the thermodynamic processes and the different modes of heat transfer that occur in case of fire. Understand the mathematical formulation of the physical processes of heat transfer. Understand the thermodynamic aspects of combustion. Recognize the occurrence of mass transfer in case of fire. Calculate flue gas temperature and composition in case of combustion. Understand and apply the first law of thermodynamics.
E051482 Active Fire Protection I: Detection and Suppression	lecture seminar project	open book examination report oral examination	Make a critical assessment of the different manual suppression systems and automatic suppression methods for different incident types, by means of calculations and technical considerations. Make a critical assessment, by means of calculations and technical considerations, of different fire detection methods. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment.
E051494 Active Fire Protection II: Smoke and Heat Control	lecture seminar: coached exercises project	written examination report oral examination open book examination	Perform a critical evaluation of a smoke and heat control system design Compute and critically evaluate the removal of heat from an enclosure Make a correct CFD calculation in the context of a smoke and heat control system design Explain the processes involved in the production of smoke in case of fire Compute and critically evaluate the movement of smoke inside, into and out of an enclosure Calculate an original design of smoke and heat control systems for a realistic configuration Apply national and international standards and regulative documents for the design of smoke control systems
E051610 Passive Fire Protection	lecture online lecture seminar: coached exercises	written examination	Classify a building product based on test results Analyse a construction detail for passive fire protection systems Give an overview of fire protection systems possible for different applications, including their respective advantages and disadvantages
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.

E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.
E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.

E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	written examination with open questions job performance assessment assignment participation written examination with multiple choice questions	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work	report	Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models.
E051494 Active Fire Protection II: Smoke and Heat Control	project	open book examination report oral examination	Perform a critical evaluation of a smoke and heat control system design Make a correct CFD calculation in the context of a smoke and heat control system design Calculate an original design of smoke and heat control systems for a realistic configuration
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.
E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.

E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	written examination with open questions job performance assessment assignment participation written examination with multiple choice questions	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.

<< **EMingwFIRE1.1 Master and apply knowledge of physics, chemistry, thermodynamics, heat and mass transfer to critically analyse and evaluate the development of fires in enclosures.** *Competences in one/more scientific discipline(s)*

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities project lecture	report	Skills: Determine the uncertainties in the design. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Knowledge: Master and apply the advanced knowledge of previous courses by integrating the fire protection techniques into a global risk performance based design.
E051430 Fire Dynamics	lecture seminar: coached exercises practicum	written examination oral examination open book examination	Analyse fire dynamics in an enclosure.
E039161 Thermodynamics, Heat and Mass Transfer	lecture seminar: coached exercises	written examination oral examination	Understand and calculate the consequences of heat transfer in case of fire. Solve a new complex problem, involving the thermodynamic processes and the different modes of heat transfer that occur in case of fire. Recognize the occurrence of mass transfer in case of fire.
E051570 Material Behaviour at Ambient and Elevated Temperatures	lecture lecture: plenary exercises	oral examination	Recommend materials as function of the requested application Know, compare and interpret in a critical manner the temperature dependent properties of different materials
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	written examination with open questions job performance assessment assignment participation written examination with multiple choice questions	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

<< **EMingwFIRE1.2 Master and apply knowledge of element methods and dynamics of structures to critically analyse and evaluate the behaviour of simple structures in case of fire.** *Competences in one/more scientific discipline(s)*

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities lecture	report	Skills: Make and evaluate approximate estimates in a design. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Attitudes: Take up independent positions about fire safety designs and defend the point of view. Knowledge: Use functional criteria (performance) as a criterion in order to realise and evaluate an original fire safety design.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	report	Knowledge: Draw the appropriate safety conclusions from the risk analysis. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Knowledge: Use functional criteria (performance) as a criterion in order to realise and evaluate an original fire safety design. Knowledge: Evaluate self-reliantly the fire risk in a project. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Attitudes: Be aware of the own expertise and improve to expert level. Skills: Determine the uncertainties in the design.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

<< **EMingwFIRE1.4 Master and apply the advanced knowledge of fire dynamics, risk assessment, human behaviour and integrate this to develop a performance based fire safety design.** *Competences in one/more scientific discipline(s)*

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities project lecture	written examination with open questions report assignment participation	Knowledge: Draw the appropriate safety conclusions from the risk analysis. Attitudes: Reflect on own way of thinking and acting. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Attitudes: Take up independent positions about fire safety designs and defend the point of view. Knowledge: Use functional criteria (performance) as a criterion in order to realise and evaluate an original fire safety design. Skills: Report performance based design orally, in writing and with graphical methods. Skills: Control the results of a performance based design. Knowledge: Evaluate self-reliantly the fire risk in a project. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Attitudes: Be aware of on-going evolutions in the field of interest. Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Attitudes: Communicate and collaborate with colleagues. Skills: Discuss performance based design in the English language. Skills: Make and evaluate approximate estimates in a design. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Attitudes: Collaborate in the multidisciplinary environment of Fire Safety Engineering. Attitudes: Be aware of the own expertise and improve to expert level. Knowledge: Master and apply the advanced knowledge of previous courses by integrating the fire protection techniques into a global risk performance based design. Skills: Determine the uncertainties in the design.
E051430 Fire Dynamics	lecture seminar: coached exercises practicum	written examination oral examination	Analyse fire dynamics in an enclosure.
E900527 Fire Science and Fire Dynamics	lecture	written examination skills test	Demonstrate understanding of the science which underpins current fire safety engineering calculations. Give appropriate consideration to uncertainties in fire problems. Perform certain typical fire safety engineering calculations, such as sprinkler activation times and compartment smoke filling, using a spread sheet model. Explain fire behaviour in each of the stages in a compartment fire. Estimate certain parameters of fires such as flame length, heat release rate, plume temperature and smoke production, for simple, well defined fuel packages.
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	written examination with open questions	Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Knowledge: Evaluate self-reliantly the fire risk in a project.
E051581 Fire Research Seminar	lecture lecture: plenary exercises project	assignment job performance assessment	Report in a structured and scientific manner, using appropriate language Perform a comprehensive literature study on a specified fire related topic, including scientific referencing Schedule work on a dedicated project, plan ahead and report intermediate steps
E039161 Thermodynamics, Heat and Mass Transfer	lecture seminar: coached exercises	written examination oral examination	Understand the mathematical formulation of the physical processes of heat transfer. Solve a new complex problem, involving the thermodynamic processes and the different modes of heat transfer that occur in case of fire.
E051482 Active Fire Protection I: Detection and Suppression	lecture seminar project	open book examination report oral examination	Make a critical assessment of the different manual suppression systems and automatic suppression methods for different incident types, by means of calculations and technical considerations. Make a critical assessment, by means of calculations and technical considerations, of different fire detection methods. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment.
E051494 Active Fire Protection II: Smoke and Heat Control	lecture seminar: coached exercises project	written examination report oral examination open book examination	Calculate an original design of smoke and heat control systems for a realistic configuration Compute and critically evaluate the removal of heat from an enclosure Make a correct CFD calculation in the context of a smoke and heat control system design Compute and critically evaluate the movement of smoke inside, into and out of an enclosure
E051610 Passive Fire Protection	lecture online lecture seminar: coached exercises	written examination	Analyse a construction detail for passive fire protection systems
E900527 Fire Science and Fire Dynamics	lecture	written examination skills test	Demonstrate understanding of the science which underpins current fire safety engineering calculations. Give appropriate consideration to uncertainties in fire problems. Perform certain typical fire safety engineering calculations, such as sprinkler activation times and compartment smoke filling, using a spread sheet model. Explain fire behaviour in each of the stages in a compartment fire. Estimate certain parameters of fires such as flame length, heat release rate, plume temperature and smoke production, for simple, well defined fuel packages.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	written examination with open questions job performance assessment assignment participation written examination with multiple choice questions	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Attitudes: Be aware of the own expertise and improve to expert level. Attitudes: Reflect on own way of thinking and acting. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Attitudes: Be aware of on-going evolutions in the field of interest. Attitudes: Collaborate in the multidisciplinary environment of Fire Safety Engineering.
E051581 Fire Research Seminar	lecture lecture: plenary exercises project	assignment	Report in a structured and scientific manner, using appropriate language Perform a comprehensive literature study on a specified fire related topic, including scientific referencing Present to audiences with different backgrounds
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models

E900525	Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105	Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Determine the uncertainties in the design. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Knowledge: Master and apply the advanced knowledge of previous courses by integrating the fire protection techniques into a global risk performance based design.
E051581 Fire Research Seminar	lecture: plenary exercises	oral examination assignment	Perform a systematic data analysis.
E051570 Material Behaviour at Ambient and Elevated Temperatures	lecture lecture: plenary exercises	oral examination	Understand testing methods to determine properties of materials Know, compare and interpret in a critical manner the temperature dependent properties of different materials Recommend materials as function of the requested application
E051482 Active Fire Protection I: Detection and Suppression	lecture seminar project	open book examination report oral examination	Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment. Design, together with colleagues, a fire detection installation for a building.
E051494 Active Fire Protection II: Smoke and Heat Control	project	open book examination report oral examination	Calculate an original design of smoke and heat control systems for a realistic configuration Make a correct CFD calculation in the context of a smoke and heat control system design
E900527 Fire Science and Fire Dynamics	lecture	written examination skills test	Demonstrate understanding of the science which underpins current fire safety engineering calculations. Give appropriate consideration to uncertainties in fire problems. Perform certain typical fire safety engineering calculations, such as sprinkler activation times and compartment smoke filling, using a spread sheet model. Explain fire behaviour in each of the stages in a compartment fire. Estimate certain parameters of fires such as flame length, heat release rate, plume temperature and smoke production, for simple, well defined fuel packages.
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	written examination with open questions job performance assessment assignment participation written examination with multiple choice questions	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Make and evaluate approximate estimates in a design. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models.
E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Determine the uncertainties in the design. Attitudes: Reflect on own way of thinking and acting. Knowledge: Evaluate self-reliantly the fire risk in a project. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Attitudes: Communicate and collaborate with colleagues. Skills: Make and evaluate approximate estimates in a design. Attitudes: Collaborate in the multidisciplinary environment of Fire Safety Engineering. Attitudes: Be aware of the own expertise and improve to expert level.
E051581 Fire Research Seminar	lecture lecture: plenary exercises project	assignment job performance assessment	Report in a structured and scientific manner, using appropriate language Perform a comprehensive literature study on a specified fire related topic, including scientific referencing Schedule work on a dedicated project, plan ahead and report intermediate steps Present to audiences with different backgrounds
E051494 Active Fire Protection II: Smoke and Heat Control	project	open book examination report oral examination	Perform a critical evaluation of a smoke and heat control system design Make a correct CFD calculation in the context of a smoke and heat control system design Calculate an original design of smoke and heat control systems for a realistic configuration
E900527 Fire Science and Fire Dynamics	lecture	written examination skills test	Demonstrate understanding of the science which underpins current fire safety engineering calculations. Give appropriate consideration to uncertainties in fire problems. Perform certain typical fire safety engineering calculations, such as sprinkler activation times and compartment smoke filling, using a spread sheet model. Explain fire behaviour in each of the stages in a compartment fire. Estimate certain parameters of fires such as flame length, heat release rate, plume temperature and smoke production, for simple, well defined fuel packages.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Knowledge: Draw the appropriate safety conclusions from the risk analysis. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Attitudes: Take up independent positions about fire safety designs and defend the point of view. Skills: Control the results of a performance based design. Knowledge: Evaluate self-reliantly the fire risk in a project. Skills: Discuss performance based design in the English language. Skills: Make and evaluate approximate estimates in a design. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Skills: Determine the uncertainties in the design.
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities project lecture	assignment report	Skills: Determine the uncertainties in the design. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Skills: Report performance based design orally, in writing and with graphical methods. Skills: Control the results of a performance based design. Knowledge: Evaluate self-reliantly the fire risk in a project. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Attitudes: Communicate and collaborate with colleagues. Skills: Discuss performance based design in the English language. Skills: Make and evaluate approximate estimates in a design. Attitudes: Collaborate in the multidisciplinary environment of Fire Safety Engineering. Knowledge: Master and apply the advanced knowledge of previous courses by integrating the fire protection techniques into a global risk performance based design.
E051494 Active Fire Protection II: Smoke and Heat Control	lecture project	open book examination report oral examination	Calculate an original design of smoke and heat control systems for a realistic configuration Make a correct CFD calculation in the context of a smoke and heat control system design
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	written examination with open questions job performance assessment assignment participation written examination with multiple choice questions	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Determine the uncertainties in the design. Attitudes: Reflect on own way of thinking and acting. Skills: Report performance based design orally, in writing and with graphical methods. Skills: Control the results of a performance based design. Knowledge: Evaluate self-reliantly the fire risk in a project. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Skills: Discuss performance based design in the English language. Skills: Make and evaluate approximate estimates in a design. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Attitudes: Be aware of the own expertise and improve to expert level.
E051581 Fire Research Seminar	lecture lecture: plenary exercises project	oral examination job performance assessment assignment	Report in a structured and scientific manner, using appropriate language Perform a comprehensive literature study on a specified fire related topic, including scientific referencing Schedule work on a dedicated project, plan ahead and report intermediate steps Present to audiences with different backgrounds
E039161 Thermodynamics, Heat and Mass Transfer	lecture seminar: coached exercises	written examination oral examination	Solve a new complex problem, involving the thermodynamic processes and the different modes of heat transfer that occur in case of fire.
E051482 Active Fire Protection I: Detection and Suppression	project	oral examination report	Write a report and present it orally to colleagues, with respect to the design of an automatic fire protection installation. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment.
E051494 Active Fire Protection II: Smoke and Heat Control	lecture project	open book examination report oral examination	Perform a critical evaluation of a smoke and heat control system design Make a correct CFD calculation in the context of a smoke and heat control system design Calculate an original design of smoke and heat control systems for a realistic configuration Apply national and international standards and regulative documents for the design of smoke control systems
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Knowledge: Master and apply the advanced knowledge of previous courses by integrating the fire protection techniques into a global risk performance based design. Attitudes: Reflect on own way of thinking and acting. Attitudes: Take up independent positions about fire safety designs and defend the point of view. Skills: Report performance based design orally, in writing and with graphical methods. Skills: Control the results of a performance based design. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Attitudes: Be aware of on-going evolutions in the field of interest. Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Skills: Discuss performance based design in the English language. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk.
E051482 Active Fire Protection I: Detection and Suppression	project	oral examination report	Write a report and present it orally to colleagues, with respect to the design of an automatic fire protection installation. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment.
E051494 Active Fire Protection II: Smoke and Heat Control	lecture project	open book examination report oral examination	Calculate an original design of smoke and heat control systems for a realistic configuration Make a correct CFD calculation in the context of a smoke and heat control system design
E900527 Fire Science and Fire Dynamics	lecture	written examination skills test	Demonstrate understanding of the science which underpins current fire safety engineering calculations. Give appropriate consideration to uncertainties in fire problems. Perform certain typical fire safety engineering calculations, such as sprinkler activation times and compartment smoke filling, using a spread sheet model. Explain fire behaviour in each of the stages in a compartment fire. Estimate certain parameters of fires such as flame length, heat release rate, plume temperature and smoke production, for simple, well defined fuel packages.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Attitudes: Be aware of the own expertise and improve to expert level. Attitudes: Reflect on own way of thinking and acting. Attitudes: Take up independent positions about fire safety designs and defend the point of view. Knowledge: Evaluate self-reliantly the fire risk in a project. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Attitudes: Be aware of on-going evolutions in the field of interest. Skills: Analyse own results and results of others within fire performance based designs in an objective manner.
E051482 Active Fire Protection I: Detection and Suppression	project	oral examination report	Write a report and present it orally to colleagues, with respect to the design of an automatic fire protection installation. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment.
E051494 Active Fire Protection II: Smoke and Heat Control	lecture project	open book examination report oral examination	Perform a critical evaluation of a smoke and heat control system design Make a correct CFD calculation in the context of a smoke and heat control system design Calculate an original design of smoke and heat control systems for a realistic configuration
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	written examination with open questions job performance assessment assignment participation written examination with multiple choice questions	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	lecture self-reliant study activities	participation report assignment	Attitudes: Be aware of the own expertise and improve to expert level. Attitudes: Be aware of on-going evolutions in the field of interest.
E051482 Active Fire Protection I: Detection and Suppression	lecture seminar project	open book examination report oral examination	Make a critical assessment of the different manual suppression systems and automatic suppression methods for different incident types, by means of calculations and technical considerations. Make a critical assessment, by means of calculations and technical considerations, of different fire detection methods. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment.
E051443 Fire Safety and Legislation	lecture	open book examination	adopt an attitude aimed at the follow-up and application of the most recent legislation
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Attitudes: Collaborate in the multidisciplinary environment of Fire Safety Engineering. Knowledge: Evaluate self-reliantly the fire risk in a project. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Attitudes: Communicate and collaborate with colleagues.
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities project lecture	written examination with open questions report assignment participation	Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Attitudes: Reflect on own way of thinking and acting. Skills: Report performance based design orally, in writing and with graphical methods. Skills: Control the results of a performance based design. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Skills: Discuss performance based design in the English language.
E051570 Material Behaviour at Ambient and Elevated Temperatures	lecture lecture: plenary exercises	oral examination	Understand testing methods to determine properties of materials Know, compare and interpret in a critical manner the temperature dependent properties of different materials Recommend materials as function of the requested application
E051482 Active Fire Protection I: Detection and Suppression	lecture seminar project	open book examination report oral examination	Make a critical assessment of the different manual suppression systems and automatic suppression methods for different incident types, by means of calculations and technical considerations. Make a critical assessment, by means of calculations and technical considerations, of different fire detection methods. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment. Write a report and present it orally to colleagues, with respect to the design of an automatic fire protection installation.
E051494 Active Fire Protection II: Smoke and Heat Control	project	open book examination report oral examination	Perform a critical evaluation of a smoke and heat control system design Make a correct CFD calculation in the context of a smoke and heat control system design Calculate an original design of smoke and heat control systems for a realistic configuration
E051610 Passive Fire Protection	lecture online lecture seminar: coached exercises	written examination	Classify a building product based on test results Analyse a construction detail for passive fire protection systems Give an overview of fire protection systems possible for different applications, including their respective advantages and disadvantages
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work project lecture	written examination with open questions report assignment participation	Attitudes: Collaborate in the multidisciplinary environment of Fire Safety Engineering. Attitudes: Communicate and collaborate with colleagues. Skills: Discuss performance based design in the English language.
E051430 Fire Dynamics	lecture practicum	oral examination	Analyse fire dynamics in an enclosure.
E051581 Fire Research Seminar	lecture lecture: plenary exercises project	oral examination job performance assessment assignment	Report in a structured and scientific manner, using appropriate language Present to audiences with different backgrounds
E051482 Active Fire Protection I: Detection and Suppression	project	oral examination report	Write a report and present it orally to colleagues, with respect to the design of an automatic fire protection installation.
E051494 Active Fire Protection II: Smoke and Heat Control	lecture seminar: coached exercises project	written examination report oral examination open book examination	Perform a critical evaluation of a smoke and heat control system design Make a correct CFD calculation in the context of a smoke and heat control system design Calculate an original design of smoke and heat control systems for a realistic configuration Apply national and international standards and regulative documents for the design of smoke control systems
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	written examination with open questions job performance assessment assignment participation written examination with multiple choice questions	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Determine the uncertainties in the design. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Skills: Report performance based design orally, in writing and with graphical methods. Skills: Control the results of a performance based design. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Skills: Discuss performance based design in the English language. Skills: Make and evaluate approximate estimates in a design. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk.
E051581 Fire Research Seminar	lecture lecture: plenary exercises project	assignment job performance assessment	Report in a structured and scientific manner, using appropriate language Perform a comprehensive literature study on a specified fire related topic, including scientific referencing Schedule work on a dedicated project, plan ahead and report intermediate steps
E051482 Active Fire Protection I: Detection and Suppression	project	report	Write a report and present it orally to colleagues, with respect to the design of an automatic fire protection installation. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment.
E051494 Active Fire Protection II: Smoke and Heat Control	project	report	Calculate an original design of smoke and heat control systems for a realistic configuration Make a correct CFD calculation in the context of a smoke and heat control system design
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course		Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*				
E061522	Performance-Based Design	group work project lecture	participation report assignment	Attitudes: Collaborate in the multidisciplinary environment of Fire Safety Engineering. Attitudes: Take up independent positions about fire safety designs and defend the point of view. Skills: Control the results of a performance based design. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design.
E051482	Active Fire Protection I: Detection and Suppression	project	report	Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment. Design, together with colleagues, a fire detection installation for a building.
E051494	Active Fire Protection II: Smoke and Heat Control	project	oral examination	Calculate an original design of smoke and heat control systems for a realistic configuration Make a correct CFD calculation in the context of a smoke and heat control system design
E900531	Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532	Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900304	Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.
E900306	Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models

E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work project lecture	participation report assignment	Skills: Report performance based design orally, in writing and with graphical methods.
E051581 Fire Research Seminar	lecture lecture: plenary exercises project	oral examination job performance assessment assignment	Report in a structured and scientific manner, using appropriate language Present to audiences with different backgrounds
E051482 Active Fire Protection I: Detection and Suppression	project	report	Write a report and present it orally to colleagues, with respect to the design of an automatic fire protection installation. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment.
E051494 Active Fire Protection II: Smoke and Heat Control	project	oral examination report	Calculate an original design of smoke and heat control systems for a realistic configuration Make a correct CFD calculation in the context of a smoke and heat control system design
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.
E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.

E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation assignment	oral examination	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work project lecture	participation report assignment	Attitudes: Collaborate in the multidisciplinary environment of Fire Safety Engineering. Attitudes: Communicate and collaborate with colleagues. Skills: Discuss performance based design in the English language.
E051581 Fire Research Seminar	lecture lecture: plenary exercises project	assignment job performance assessment	Report in a structured and scientific manner, using appropriate language Schedule work on a dedicated project, plan ahead and report intermediate steps Present to audiences with different backgrounds
E051494 Active Fire Protection II: Smoke and Heat Control	project	oral examination report	Perform a critical evaluation of a smoke and heat control system design Make a correct CFD calculation in the context of a smoke and heat control system design Calculate an original design of smoke and heat control systems for a realistic configuration Apply national and international standards and regulative documents for the design of smoke control systems
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Attitudes: Reflect on own way of thinking and acting. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design.
E051482 Active Fire Protection I: Detection and Suppression	project	report	Write a report and present it orally to colleagues, with respect to the design of an automatic fire protection installation. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment.
E051494 Active Fire Protection II: Smoke and Heat Control	project	oral examination report	Calculate an original design of smoke and heat control systems for a realistic configuration Make a correct CFD calculation in the context of a smoke and heat control system design
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	only evaluation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Skills: Control the results of a performance based design.
E051494 Active Fire Protection II: Smoke and Heat Control	project	oral examination report	Apply national and international standards and regulative documents for the design of smoke control systems
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	lecture self-reliant study activities	participation	Attitudes: Be aware of on-going evolutions in the field of interest.
E900527 Fire Science and Fire Dynamics	lecture	written examination skills test	Demonstrate understanding of the science which underpins current fire safety engineering calculations. Give appropriate consideration to uncertainties in fire problems. Perform certain typical fire safety engineering calculations, such as sprinkler activation times and compartment smoke filling, using a spread sheet model. Explain fire behaviour in each of the stages in a compartment fire. Estimate certain parameters of fires such as flame length, heat release rate, plume temperature and smoke production, for simple, well defined fuel packages.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Attitudes: Collaborate in the multidisciplinary environment of Fire Safety Engineering. Skills: Report performance based design orally, in writing and with graphical methods. Skills: Control the results of a performance based design. Knowledge: Evaluate self-reliantly the fire risk in a project. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Attitudes: Communicate and collaborate with colleagues. Skills: Discuss performance based design in the English language. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk.
E051494 Active Fire Protection II: Smoke and Heat Control	project	oral examination report	Apply national and international standards and regulative documents for the design of smoke control systems
E051443 Fire Safety and Legislation	lecture	open book examination	critical insight into existing legislation and regulations adopt an attitude aimed at the follow-up and application of the most recent legislation
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Attitudes: Reflect on own way of thinking and acting. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design.
E051494 Active Fire Protection II: Smoke and Heat Control	lecture seminar: coached exercises project	written examination report oral examination open book examination	Perform a critical evaluation of a smoke and heat control system design Make a correct CFD calculation in the context of a smoke and heat control system design Calculate an original design of smoke and heat control systems for a realistic configuration
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Determine the uncertainties in the design. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Skills: Report performance based design orally, in writing and with graphical methods. Skills: Control the results of a performance based design. Skills: Discuss performance based design in the English language. Skills: Make and evaluate approximate estimates in a design. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk.
E051494 Active Fire Protection II: Smoke and Heat Control	project	oral examination report	Calculate an original design of smoke and heat control systems for a realistic configuration Make a correct CFD calculation in the context of a smoke and heat control system design
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models. Skills: Control the results of a performance based design. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Skills: Discuss performance based design in the English language. Skills: Make and evaluate approximate estimates in a design.
E051482 Active Fire Protection I: Detection and Suppression	project	oral examination report	Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment. Design, together with colleagues, a fire detection installation for a building.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models

E900525	Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105	Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models.
E051581 Fire Research Seminar	lecture lecture: plenary exercises project	assignment job performance assessment	Report in a structured and scientific manner, using appropriate language Perform a comprehensive literature study on a specified fire related topic, including scientific referencing Present to audiences with different backgrounds
E051482 Active Fire Protection I: Detection and Suppression	project	oral examination report	Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment. Design, together with colleagues, a fire detection installation for a building.
E051494 Active Fire Protection II: Smoke and Heat Control	project	oral examination report	Calculate an original design of smoke and heat control systems for a realistic configuration Make a correct CFD calculation in the context of a smoke and heat control system design
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities		Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	written examination with open questions report assignment participation	Skills: Determine the uncertainties in the design. Attitudes: Reflect on own way of thinking and acting. Attitudes: Take up independent positions about fire safety designs and defend the point of view. Knowledge: Evaluate self-reliantly the fire risk in a project. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Skills: Analyse own results and results of others within fire performance based designs in an objective manner. Skills: Make and evaluate approximate estimates in a design. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Attitudes: Be aware of the own expertise and improve to expert level.
E051482 Active Fire Protection I: Detection and Suppression	project	oral examination report	Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment. Design, together with colleagues, a fire detection installation for a building.
E051494 Active Fire Protection II: Smoke and Heat Control	lecture seminar: coached exercises project	written examination report oral examination open book examination	Perform a critical evaluation of a smoke and heat control system design Compute and critically evaluate the removal of heat from an enclosure Make a correct CFD calculation in the context of a smoke and heat control system design Compute and critically evaluate the movement of smoke inside, into and out of an enclosure Calculate an original design of smoke and heat control systems for a realistic configuration
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.

E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models
E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	written examination with open questions job performance assessment assignment participation written examination with multiple choice questions	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E051540 Explosions and Industrial Fire Safety	lecture seminar	open book examination	TOPICS: industrial fire and explosion protection. COMPETENCES: assess the fire and explosion risks involved with the use, handling, transport or storage of liquid, gaseous and/or solid materials and to take the appropriate technical and organisation measures to reduce such a risk to an acceptable level. INSIGHTS: understand the physical processes that occur during explosions.
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Skills: Select, motivate and apply the proper models, methods and techniques for risk based engineering models.
E051482 Active Fire Protection I: Detection and Suppression	project	report	Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment. Design, together with colleagues, a fire detection installation for a building.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk.
E051610 Passive Fire Protection	lecture online lecture	written examination	Give an overview of fire protection systems possible for different applications, including their respective advantages and disadvantages
E900531 Fire Science Laboratory	practicum	report	Demonstrate understanding of ignition (solid and liquid/gaseous). Demonstrate understanding of fire dynamics, including fire plumes Demonstrate understanding of oxygen consumption calorimetry. Demonstrate understanding of burning rate and fire spread.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;

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E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Knowledge: Draw the appropriate safety conclusions from the risk analysis. Attitudes: Take up independent positions about fire safety designs and defend the point of view. Skills: Control the results of a performance based design. Knowledge: Evaluate self-reliantly the fire risk in a project. Attitudes: Act in an ethical, professional and social way when presenting and defining performance based design. Skills: Discuss performance based design in the English language. Skills: Make and evaluate approximate estimates in a design. Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Skills: Determine the uncertainties in the design.
E051482 Active Fire Protection I: Detection and Suppression	project	oral examination report	Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment. Design, together with colleagues, a fire detection installation for a building.
E900532 Fire Investigation and Failure Analysis	lecture seminar	written examination report assignment oral examination	Apply fundamental knowledge required to investigate fire and explosions: heat transfer, fluid mechanics material response to fire conditions, construction techniques. Appreciate the role of fire fighting systems/methods. Achieve an understanding of quantitative tools and their application. Awareness of the application of fire science and fire engineering to evaluate the behaviour of materials in fire. Solve inverse problems to reconstruct fire scenarios. Understand the legislative framework and philosophy of the courts: evidence, insurance, interpretation.
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E900304 Risk Assessment	group work self-reliant study activities seminar lecture	oral examination skills test	The aim of the course is that, in combination with earlier courses, the students gain the capability of utilizing tools for risk assessment and how they can support decisions in the area of risk management and especially in the area of fire safety engineering. Furthermore, the course is aimed at providing a foundation for continuing studies in the risk management field. *Knowledge and understanding* For a passing grade the student must: • be able to describe different perspectives of the concept of risk and be aware of the implications of adopting the different perspecives in a risk management context. • be able to describe risk assessment methods, their areas of applicability, especially in the area of fire safety engineering and their strengths and weaknesses. • be able to describe relevant risk measures, their limitations and strengths and how they can be applied to evaluate risks. • be able to describe different types of uncertainty and how they can be addressed and handled in a risk assessment context. • be able to describe how input from risk assessments can be utilised as a basis for decision-making and emergency preparedness planning. • demonstrate an understanding of various sources of information that can be used and the challenges in using them as input to risk assessments. *Skills and abilities* For a passing grade the student must: • be able to utilize, the concepts, methods and tools used in risk assessment, in new situations and in situations related to fire safety. • be able to evaluate the contents of existing risk assessments. • be able to report, both orally and in writing, and discuss the implications of a performed risk assessment in a way understandable to persons with different knowledge backgrounds. • be able to utilise material in scientific publications relevant for risk assessment. • be able to utilise methods and tools for basic decision problems concerning risks. *Judgement and approach* For a passing grade the student must: • be able to critically reflect on the benefits and limitations of risk assessments as an input to decision-making. • be able to reflect upon ethical and subjective dimensions of risk assessments.
E900306 Human Behaviour in Fire	group work self-reliant study activities seminar lecture	written examination skills test oral examination	*Knowledge and Understanding* For a passing grade the student must: • be able to explain the various factors (psychological and environmental) that influence fire setting behaviour • be able to explain RSET-models (simple stimuli-response models) that are commonly user in guidelines and regulations • be able to describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, affordances and help in emergencies) • be able to state typical walking speeds for evacuation and explain how movement of people is influenced by demographic factors (e.g. age and mobility) • be able to explain social influence and give examples of situations when social influence will be particularly important • be able to explain the basic assumptions behind egress models (network, grid and continuous models) *Skills and Abilities* For a passing grade the student must: • apply RSET-models (simple stimuli-response models) to estimate the required safe escape time • analyse a fire accident and relate the behaviour of occupants to theories of human behaviour in fire • analyse exit design based on the theory of affordances • apply egress models to simulate movement of people during evacuation • analyse results from simulations with egress models and relate the results to the assumptions of the model • select appropriate occupant behaviour scenarios for fire safety engineering design • communicate theories of human behaviour in fire to laymen and experts • communicate results from simulations with egress models to laymen and experts (oral, written and graphic representation) • independently seek information (articles, reports, manuals, etc) about human behaviour in fire *Judgement and approach* For a passing grade the student must: • adequately consider relevant scientific and ethical aspects of experiments with human participants (evacuation experiments) • adequately consider relevant ethical aspects relating to analysis of evacuation with egress models

E900525 Simulation of Fires in Enclosures	lecture self-reliant study activities	written examination with open questions job performance assessment assignment participation written examination with multiple choice questions	Knowledge and understanding: be able to describe the physical models used for conservation of mass, material, energy, and momentum. Judgement and approach: demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation. Judgement and approach:demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use Skills and abilities:be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading. Skills and abilities:be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations. Skills and abilities:be able to understand and use professional terminology within the field of fire evolution simulation using CFD Skills and abilities:be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used. Skills and abilities: be able to assess calculated results against experimental data Skills and abilities: be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs. Knowledge and understanding: be able to identify the limitations and most common sources of error of the model components used. Knowledge and understanding: be able to describe various numerical methods for solving the equation sets.

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E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Skills: Apply the concept of risk management and the fire prevention techniques in order to produce a fire safe design with an acceptable risk. Attitudes: Be aware of on-going evolutions in the field of interest.
E900305 Advanced Fire Dynamics	group work seminar: coached exercises self-reliant study activities seminar lecture	written examination skills test assignment open book examination	The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models. *Knowledge and understanding* For a passing grade the student must: • be able to explain the effect of the enclosure on a fire sequence. • be able to explain the range of application of the models and the applicable constraints for fire safety engineering computations. • be able to characterise the various stages of a fire sequence based on various variables. *Skills and abilities* For a passing grade the student must: • be able to apply various manual computation models and computer models (2-zone models) for calculating various variables in a compartment fire. • be able to calculate the value of various physical variables associated with a fire sequence. • be able to analyse and interpret results from fire safety engineering experiments. • be able to judge the reasonableness of calculated results obtained from various computational models. • be able to estimate data values for input into computational models where these are lacking in the problem statement. • be able to design fire safety engineering systems for control and handling of combustion gases. • be able to evaluate the effect the fire event can have on people occupying the building. • be able to calculate the time before critical conditions are reached for fires in a building. • be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences. • be able to present results from fire safety engineering experiments in a clear and scientific manner. • be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals. • be able to plan and carry out fire safety engineering experiments. *Judgement and approach* For a passing grade the student must: • demonstrate a capacity to make judgements on the applicability of various computation models to various types of problems. • demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.

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E061522 Performance-Based Design	group work self-reliant study activities project lecture	participation report assignment	Attitudes: Be aware of the own expertise and improve to expert level. Attitudes: Be aware of on-going evolutions in the field of interest.
E051482 Active Fire Protection I: Detection and Suppression	project	oral examination report	Write a report and present it orally to colleagues, with respect to the design of an automatic fire protection installation. Design, together with colleagues, a fire detection installation for a building. Design, together with colleagues, a fire suppression installation that is not only based on water extinguishment.
E051494 Active Fire Protection II: Smoke and Heat Control	project	oral examination report	Calculate an original design of smoke and heat control systems for a realistic configuration Make a correct CFD calculation in the context of a smoke and heat control system design
E900522 Structural Design for Fire	lecture seminar	written examination skills test assignment	Understanding the philosophical and statistical underpinnings of structural design at both ambient and elevated temperature conditions; Understand the role of loss of strength, deformation and thermal expansion and application to design of structures for fire resistance - Includes advanced analytical principles and calculations, and structural design for fire. Understanding heat transfer calculations based on standard fires - ISO 834, Parametric Temperature vs. Time Curves; Real Fires (Temperature vs. Heat Flux); Describe the effect of temperature on material properties of - Steel, concrete, wood, composites; fire proofing and thermal insulation; Survey the different analytical and empirical tools for fire calculations in both small and open plan compartments;
E091105 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem