

Innovative Programmes - Engineering New Degrees

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Historical Context

- Structure of undergraduate degrees in UCL Civil Engineering had undergone only incremental change over 30 years
- Applicants' qualifications were just “off the pace”, with UCL often seen as an insurance if applicants failed to get a place at Imperial College or Oxbridge
- School heads told us that many good students prefer degrees with a broad curriculum and avoid the straight jacket suggested by a vocational degree
- Industry emphasized the need for free-thinking and adaptable graduates with well-developed problem-solving skills

Context

- Young Civil Engineering researchers offered a student view that traditional engineering degrees are not exciting and do not provide appropriate education
- Students seen to lose motivation
- Too much teaching, with little time to think and apply knowledge
- Staff frustrated by perceived imbalance of workload
- Staff frustrated by conflict in timetable between project work and lecture-based teaching

Here we explain what has been done to address some of these issues

Aims of the new degree programmes

- To attract the brightest students into an engineering education
- To produce graduates capable of clear thinking, good communication skills and managing large-scale engineering projects, comfortable with complex inter-disciplinary issues, not afraid to innovate, and equipped to take on challenges beyond the vocational boundaries traditionally associated with engineering degrees
- To offer degree programmes radically different in structure and content from those of our competitors

The changes

- Simplified the choice of undergraduate degrees offered
- Admissions criteria raised
- Interview procedures modernised and streamlined

- Academic year re-shaped around major projects
- New roles found for research-focused academic staff

- Syllabus balanced between analytical methods and the context in which they can be applied
- Emphasis on the “big picture” earlier in degree programmes

- Teaching programme restructured into four cross-cutting “clusters”
- Assessment through a single 4-unit course

- Constructionarium introduced to the curriculum



Constructionarium in action

Old degrees 12 of them

- B.Eng. Civil Engineering
- B.Eng. Civil Engineering (**4 year STEPS programme**)
- B.Eng. Civil **and** Environmental Engineering
- B.Eng. Structural Engineering
- B.Eng. Geoinformatics
- B.Eng. Geospatial and Environmental Information Management
- M.Eng. Civil Engineering
- M.Eng. Civil Engineering (with a year abroad)
- M.Eng. Civil **with** Environmental Engineering
- M.Eng. Structural Engineering
- M.Eng. Geoinformatics
- M.Eng. Geospatial and Environmental Information Management

New degrees

- B.Eng. Civil Engineering
- B.Eng. Environmental Engineering
- B.Eng. Geoinformatics
- M.Eng. Civil Engineering
- M.Eng. Civil Engineering (International Programme)
- M.Eng. Environmental Engineering
- M.Eng. Environmental Engineering (International Programme)
- M.Eng. Geoinformatics

Teaching in 1st and 2nd years

- Common 1st year teaching across all programmes
 - broadening student curriculum
 - efficiency of teaching effort
- Common 2nd year teaching in Autumn Term
- Presentations by industry in November to inform students of the career choices available to them, with a final choice of degree to be made by end of the Autumn Term in 2nd year
- Specialist teaching in 2nd year Spring Term
- Specialist diets for 3rd and 4th years, with courses generally offered to more than one programme (including MSc programmes)

An Uncommon Timetable

– Quarters & Scenarios

- Teaching year (Autumn and Spring terms) is divided into four “Quarters” each lasting 5 weeks
- Quarters have four weeks of teaching and a major one-week group project known as a “Scenario”
- Teaching in the four weeks is based around lectures, seminars, laboratory classes, and visits
- There is no formal teaching during Scenario weeks, but staff are available for consultation to guide student groups towards their goals

From silos to frameworks

- Syllabus for 1st and 2nd years of old degrees
(taught in eight half-unit courses):
Structures, Soils, Fluids, Materials, Design, Mathematics, Geology, Measurement, Society
- Syllabus for 1st and 2nd years of new degrees re-mapped to clusters
(administered as a single 4-unit course):
Context, Change, Mechanisms, Tools
- Achieved by asking all staff to list core “**Learning Outcomes**” for their subject and to mark each as Context, Change, Mechanisms or Tools
- Learning Outcomes timetabled to mesh with the requirements of the multi-disciplinary Scenarios

Week no.		0	1	2	3	4	5	6	7	8	9	10	11			
Week start		24-Sep	01-Oct	08-Oct	15-Oct	22-Oct	29-Oct	05-Nov	12-Nov	19-Nov	26-Nov	03-Dec	10-Dec			
Week end		28-Sep	05-Oct	12-Oct	19-Oct	26-Oct	02-Nov	09-Nov	16-Nov	23-Nov	30-Nov	07-Dec	14-Dec			
		Induction Week	QUARTER 1					Reading Week	QUARTER 2							
Monday	09:00-10:00	See separate induction week schedule	Maths (AV Hill)	Maths (AV Hill)	Maths (AV Hill)	Maths (AV Hill)	Scenario 1 (G.08)		Maths (AV Hill)	Maths (AV Hill)	Maths (AV Hill)	Maths (AV Hill)	Scenario 2 (G.08)			
	10:00-11:00		Structures (DLT)	Structures (DLT)	Structures (DLT)	Structures (DLT)			Structures (DLT)	Structures (DLT)	Structures (DLT)	Structures (DLT)		Structures (DLT)		
	11:00-12:00		Fluids (DLT)	Fluids (DLT)	Fluids (DLT)	Fluids (DLT)			Fluids (DLT)	Fluids (DLT)	Fluids (DLT)	Fluids (DLT)		Fluids (DLT)		
	12:00-13:00		P/Tutorial 1	P/Tutorial 1	P/Tutorial 1	P/Tutorial 1			P/Tutorial 1	P/Tutorial 1	P/Tutorial 1	P/Tutorial 1		P/Tutorial 1		
	13:00-14:00															
	14:00-15:00		Context (26 Bedford Way--LG04)	Context (26 Bedford Way--LG04)	Context (26 Bedford Way--LG04)	Context (26 Bedford Way--LG04)			Context (26 Bedford Way--LG04)	Context (26 Bedford Way--LG04)	Context (26 Bedford Way--LG04)	Scenario 1 Feedback (G.08)		Scenario 2 Introductory Lecture (G.08)	See Lab Timetable	See Lab Timetable
	15:00-16:00															
16:00-17:00																
Tuesday	09:00-10:00	See separate induction week schedule	Materials (G.08)	Materials (G.08)	Materials (G.08)	Materials (Roberts G.08 Davies LT)	Scenario 1 (G.08)		See Lab Timetable	See Lab Timetable	See Lab Timetable	See Lab Timetable	Scenario (G.08)			
	10:00-11:00															
	11:00-12:00													Materials (G.08)		
	12:00-13:00															
	13:00-14:00															
	14:00-15:00		Materials (G.08)	Materials (G.08)	Materials (G.08)							Materials (G.08)				
	15:00-16:00															
16:00-17:00																
Wednesday	09:00-10:00	See separate induction week schedule					Scenario (G.08)						Scenario (G.08)			
	10:00-11:00		Sc 1 Intro (G.08)		Systems (G.08)				Design (G.08)	Design (G.08)	Design (G.08)					
	11:00-12:00		Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)			Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)		Maths (JZ Young)		
	12:00-13:00		Fluids (B.05)	Soils (B.05)	Fluids (B.05)	Soils (B.05)			Fluids (B.05)	Soils (B.05)	Fluids (B.05)	Soils (B.05)				
	13:00-14:00															
	14:00-15:00															
	15:00-16:00															
16:00-17:00																
Thursday	09:00-10:00	See separate induction week schedule	Env Eng (WH)	Env Eng (WH)	Env Eng (WH)	Env Eng (WH)	Scenario 1 (G.08)		Env Eng (WH)	Env Eng (WH)	Env Eng (WH)	Env Eng (WH)	Scenario (G.08)			
	10:00-11:00				Structures (WH)									Structures (WH)	Structures (WH)	
	11:00-12:00		Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)			Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)		Maths (JZ Young)		
	12:00-13:00															
	13:00-14:00															
	14:00-15:00		Context (G.08)	Context (G.08)	Context (G.08)	Context (Ramsay LT, Chemistry Bldg)			Context (G.08)	Context (G.08)	Context (G.08)	Context (Ramsay LT, Chemistry Bldg)				
	15:00-16:00															
16:00-17:00																
Friday	09:00-10:00	See separate induction week schedule				Design testing (G.04)	Scenario 1 (G.08)						Scenario (G.08)			
	10:00-11:00		Maths (B.05)	Maths (B.05)	Maths (B.05)				Maths (B.05)	Maths (B.05)	Maths (B.05)	Maths (B.05)				
	11:00-12:00		Soils (B.05)	Soils (B.05)	Soils (B.05)				Soils (B.05)	Soils (B.05)	Soils (B.05)	Soils (B.05)				
	12:00-13:00		P/Tutorial 2	P/Tutorial 2	P/Tutorial 2	P/Tutorial 2			P/Tutorial 2	P/Tutorial 2	P/Tutorial 2	P/Tutorial 2				
	13:00-14:00															
	14:00-15:00		Design (G.08)	Systems (G.08)	Geomatics (G.08)	Design (G.08)			Maths (B.05)	Materials (G.08)	Geomatics (G.08)	Scenario 2 Workshop (G.08)		Design (B.05)		
	15:00-16:00								Soils (B.05)							
16:00-17:00		Design (G.08)	Design (G.08)		Design (B.05)		Design (G.08)									

Clusters

Context:

Offers an appreciation of the technical, political, and cultural contexts of engineering and interactions with the environment. Focus on clients, planning, regulation, legislation, economics and history.

Change:

Builds on the understanding and skills gained in other parts of the syllabus to plan and realise an outcome. Focus on design skills, systems, management of projects and creativity development.

Clusters

Mechanisms:

Develops an understanding of the theories underpinning engineering processes, where and why they are similar in different fields and where and why they are different.

Tools:

Helps to develop a variety of skills, in mathematics, communications, land surveying, computing and drawing

Scenarios - the essential ingredient of our new degree programmes

- One-week multi-disciplinary projects to apply taught material and identify need for future study
- Students work in groups – different size, membership and roles for each project
- Assessment against different criteria for each project



- Each scenario run by two academics:
 - one to link curriculum to the project,
 - the other to organise the project logistics

Scenarios - the essential ingredient of our new degree programmes

Year 1:


- Traffic and pollution in St Albans – concepts
- Bridge design
- Shrimp farm in the Thames Estuary
- St Albans ii - detail



Year 2:

- Community Centre
- Offshore wind farm
- Airport expansion
- Drought in SE England

Scenarios - the essential ingredient of our new degree programmes

- Major task for staff to prepare a Scenario and make contact with relevant industrial advisors
 - Major staff commitment during Scenario week
 - Major task to arrange marking of group and individual work and subsequent feedback
- 
- A photograph showing a group of people in a meeting room. A woman in a blue top is pointing at a whiteboard. A man in a black shirt is standing next to the whiteboard. Two other people are sitting at a table with laptops and water bottles. The room has white walls and a whiteboard.
- Offers an opportunity for staff whose research interests are not part of the traditional 1st or 2nd year curriculum to play an active role in teaching

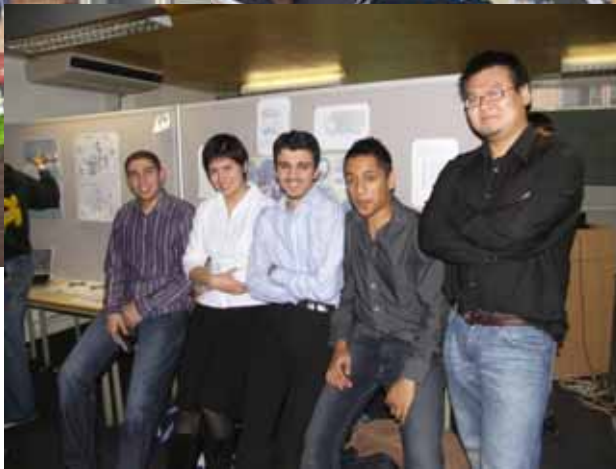
Students briefing by staff in St Albans



Site survey in St Albans



The group-thinking stage



Waiting for questions ...



Review by Chief Engineer, Atkins

Reduction in report-writing

- As in the old degree programmes, students are required to carry out laboratory experiments to underpin lecture-based teaching
- Understanding of the mechanisms being demonstrated in the experiments is assessed by short reports, by examination and in scenarios
- Full reports are required for only a few of the experiments, specifically to develop and test technical writing skills

Assessment structure – 1st and 2nd years

- Assessment for each year is managed within a single 4-unit course
- This gives flexibility to introduce small components into the curriculum without a need to create incoherent and disjointed half-units
- Marks spreadsheet gives overall performance during the year and alerts staff to poor performance in Scenarios and other coursework

Assessment structure – 1st and 2nd years

- Students have to achieve an overall pass mark AND have passed all four Clusters to proceed
- Referral tests are held in September for students whose overall mark lies in the referral band 35%-39%
- Referral tests are held in September for students who fail more than one Cluster but have an overall mark of 40% or above
- “Condoned fails” are allowed for students with an overall mark of 40% or above if only one Cluster is failed with a mark 35%-39%
- Record of Achievement also maintained to monitor student performance in “core” engineering disciplines – useful for writing references

Admissions

Criteria are now AAA

*No specific requirement for Mathematics, Physics, Chemistry or Biology;
English language requirements need attention*



Selection afternoons

- mini-scenarios*
- tours of College*
- special interviews*

The Birling Gap Question

- to defend or not to defend?*

Accreditation

- Civil and Environmental Engineering degrees are accredited by the Joint Board of Moderators: 2006 report supportive of changes
- CIWEM accredited Environmental Engineering degrees in 2009

The results so far

- In the first year of the programmes, marks in Context and Mechanisms had to be weighted to balance average marks across Clusters – successful change introduced to exam format for subsequent years
- Students are far better at managing themselves in group work on the Land Survey Field Course than those of previous years
- Most students near the bottom of the class identified as having a problem with English language – additional remedial classes have reduced this problem
- Far more students are now engaged with Global Citizenship - “International Programmes” and voluntary work overseas
- Very much better performance overall, driven by better motivation

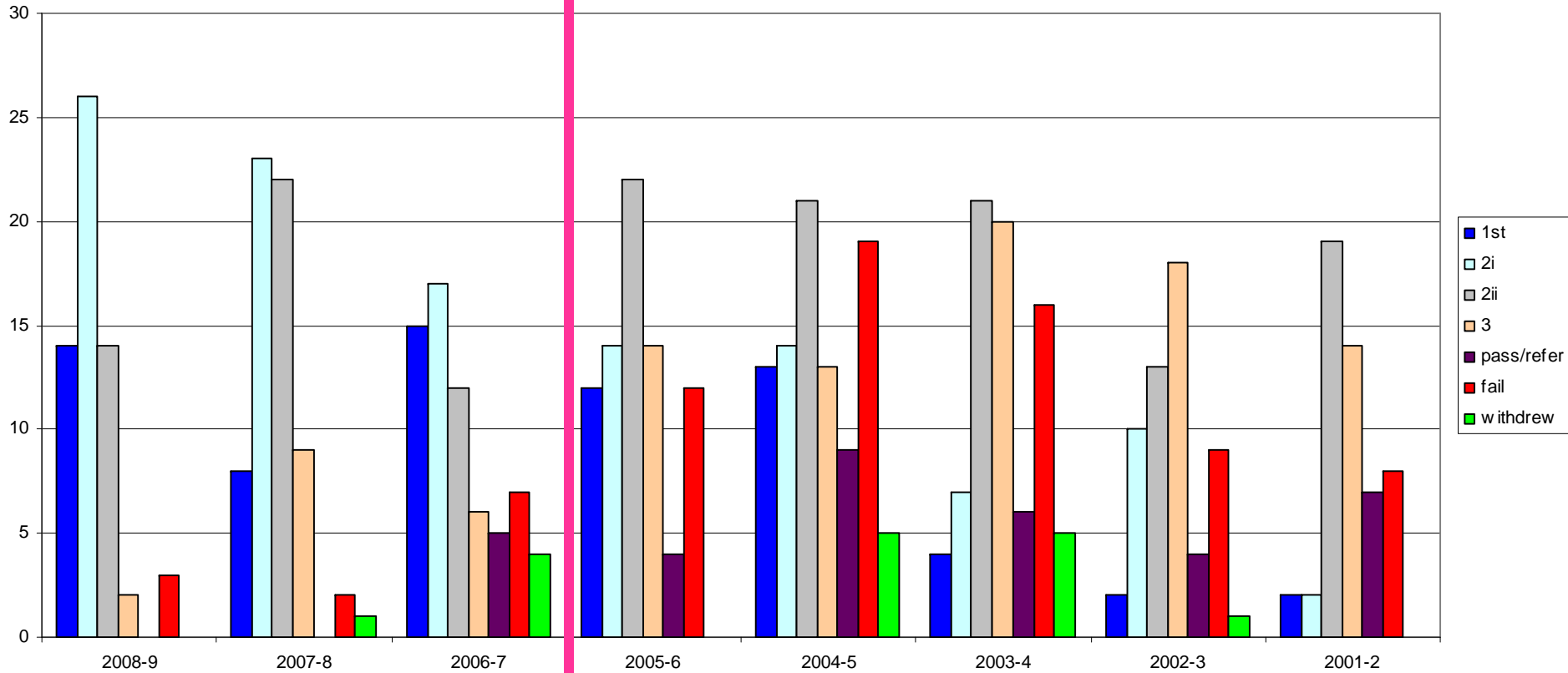
The student view:

- Very positive about Scenarios – they are stressful, but “good stress”!
- Better guidance is needed to explain initially what is expected of students during each Scenario
- Make-up of groups and poor contributions from weaker or lazy students is seen as a problem
- Teaching sessions lasting three hours were considered too long
- Optional classes are required for maths, chemistry and biology – they would welcome a pre-sessional refresher course

Negative views:

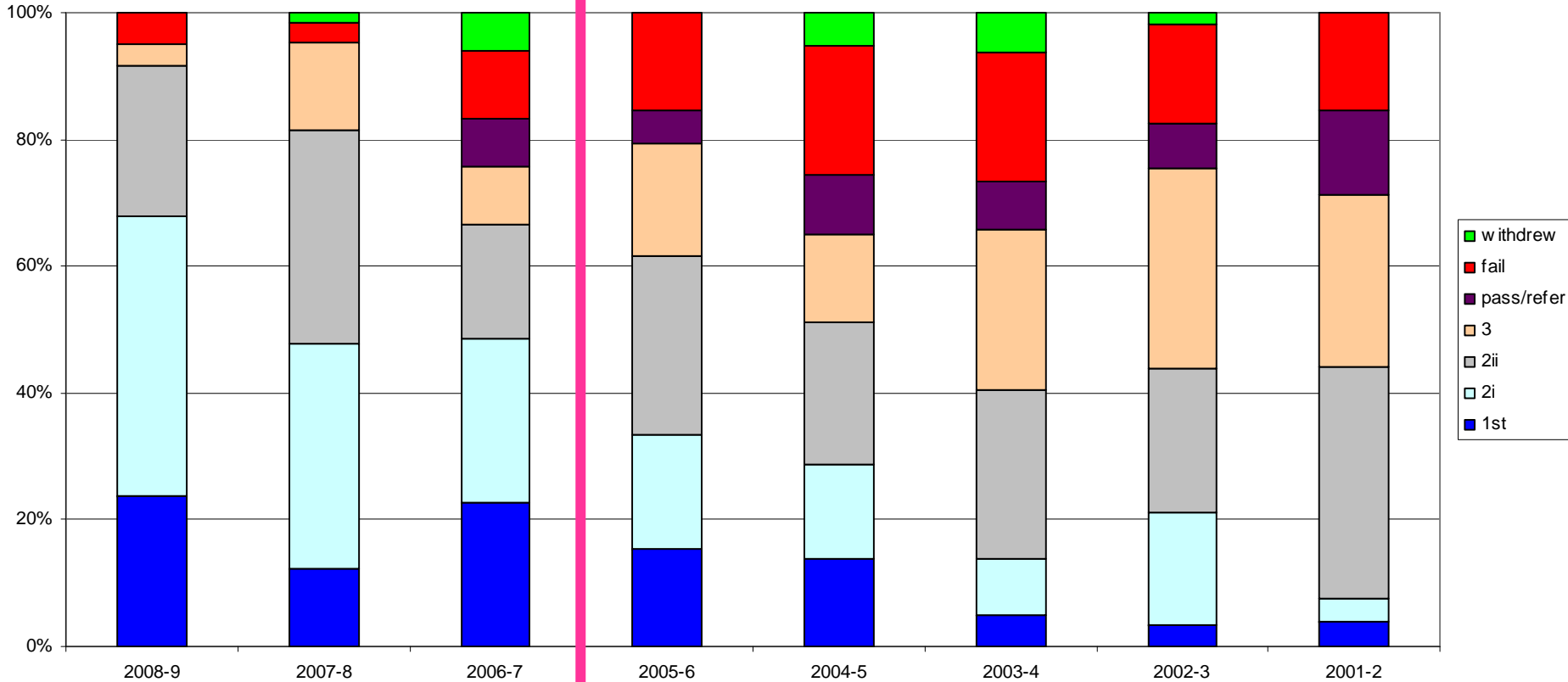
- Excessive workload
- Poor information flow
- Confusion when staff retire or change roles

1st year marks



New | **Old degree programmes**

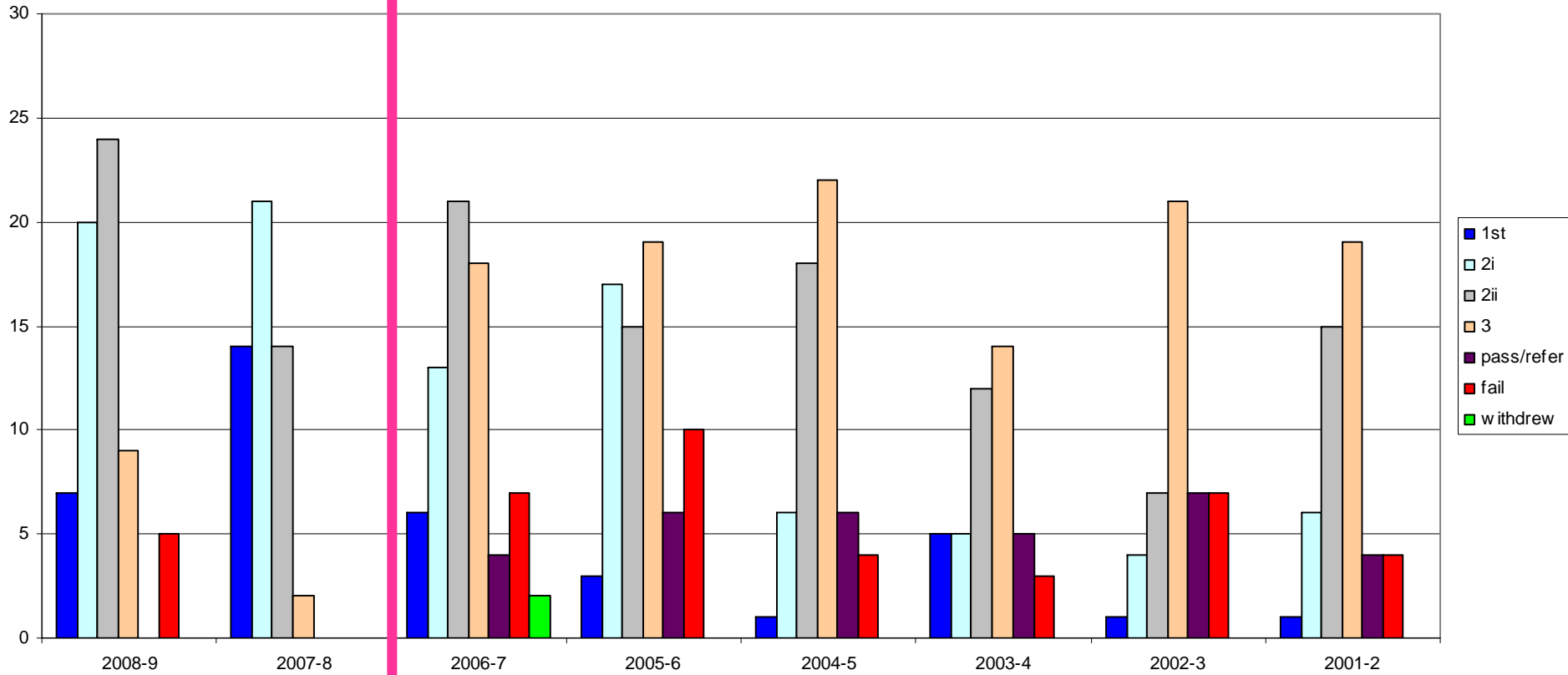
1st year marks



New

Old degree programmes

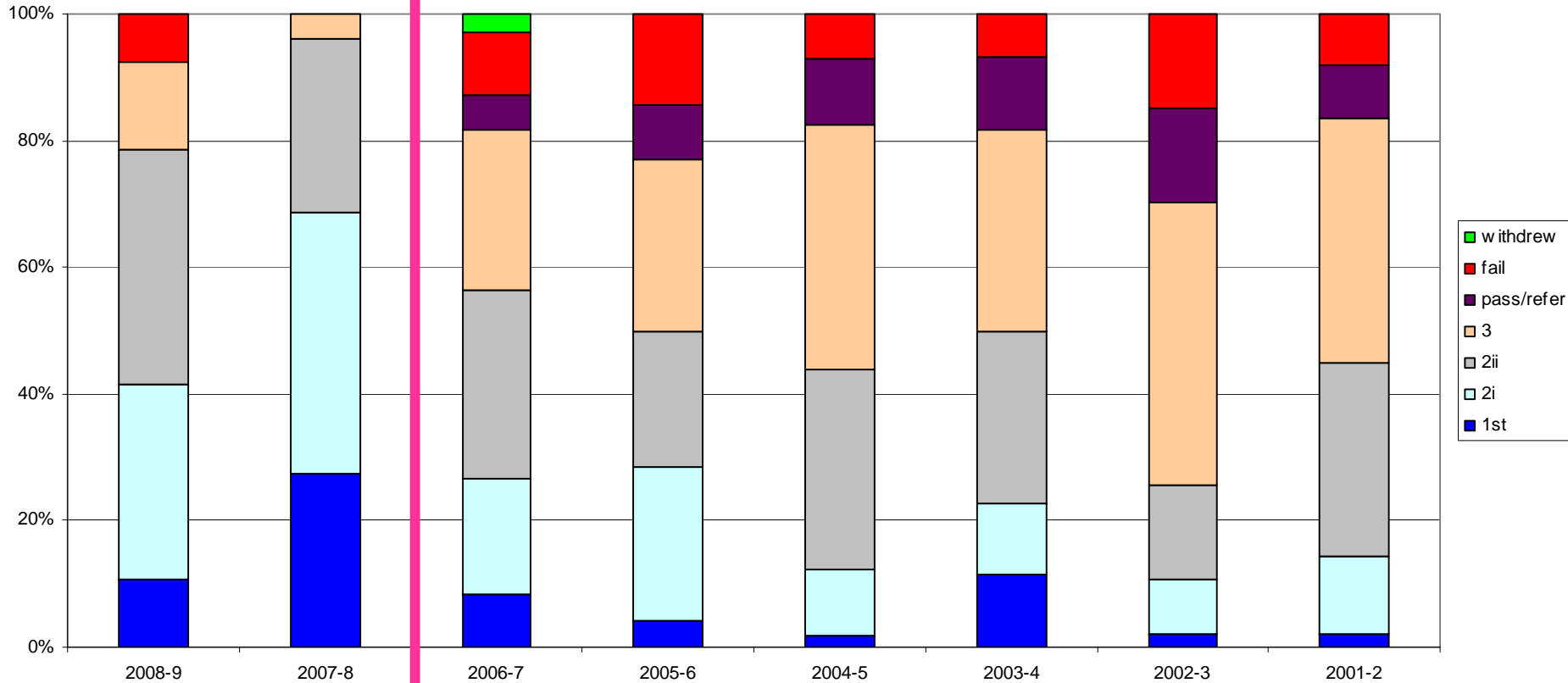
2nd year marks



New

Old degree programmes

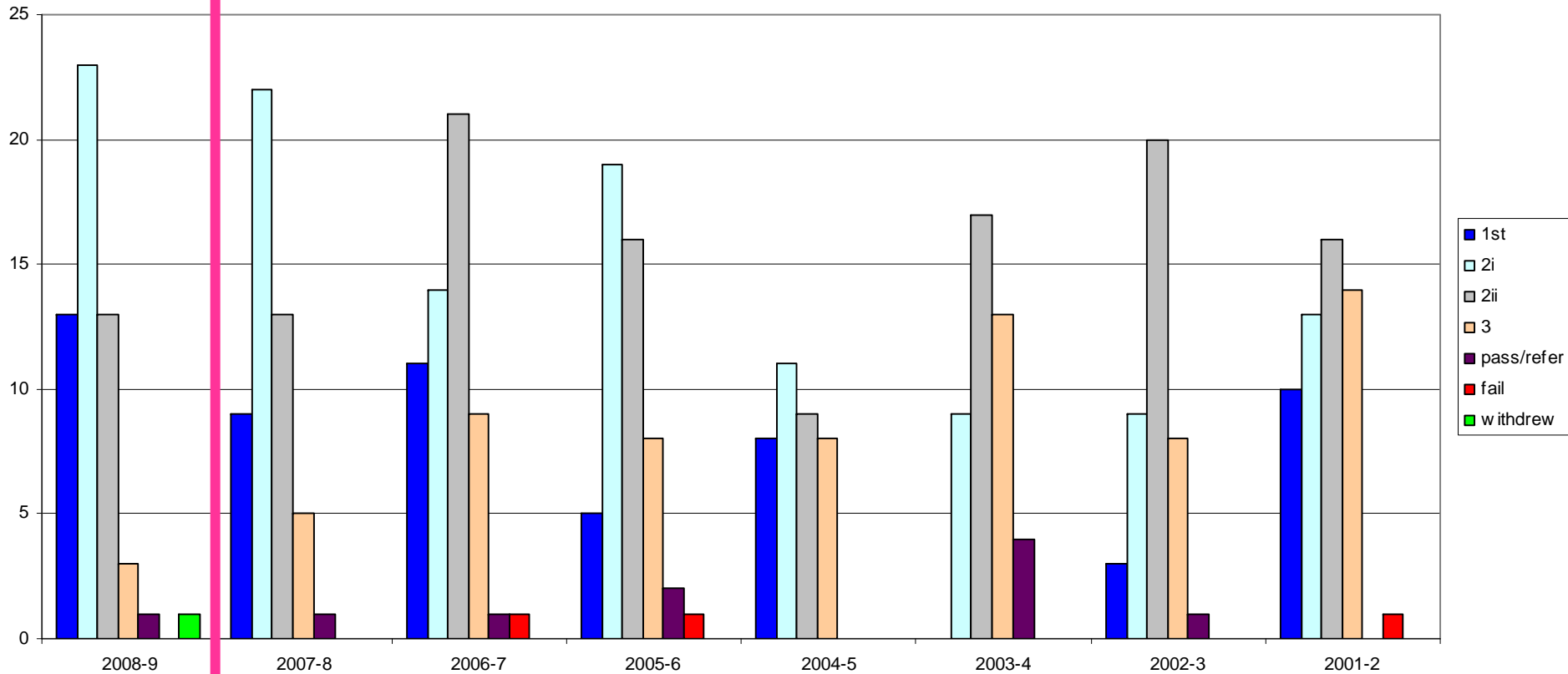
2nd year marks



New

Old degree programmes

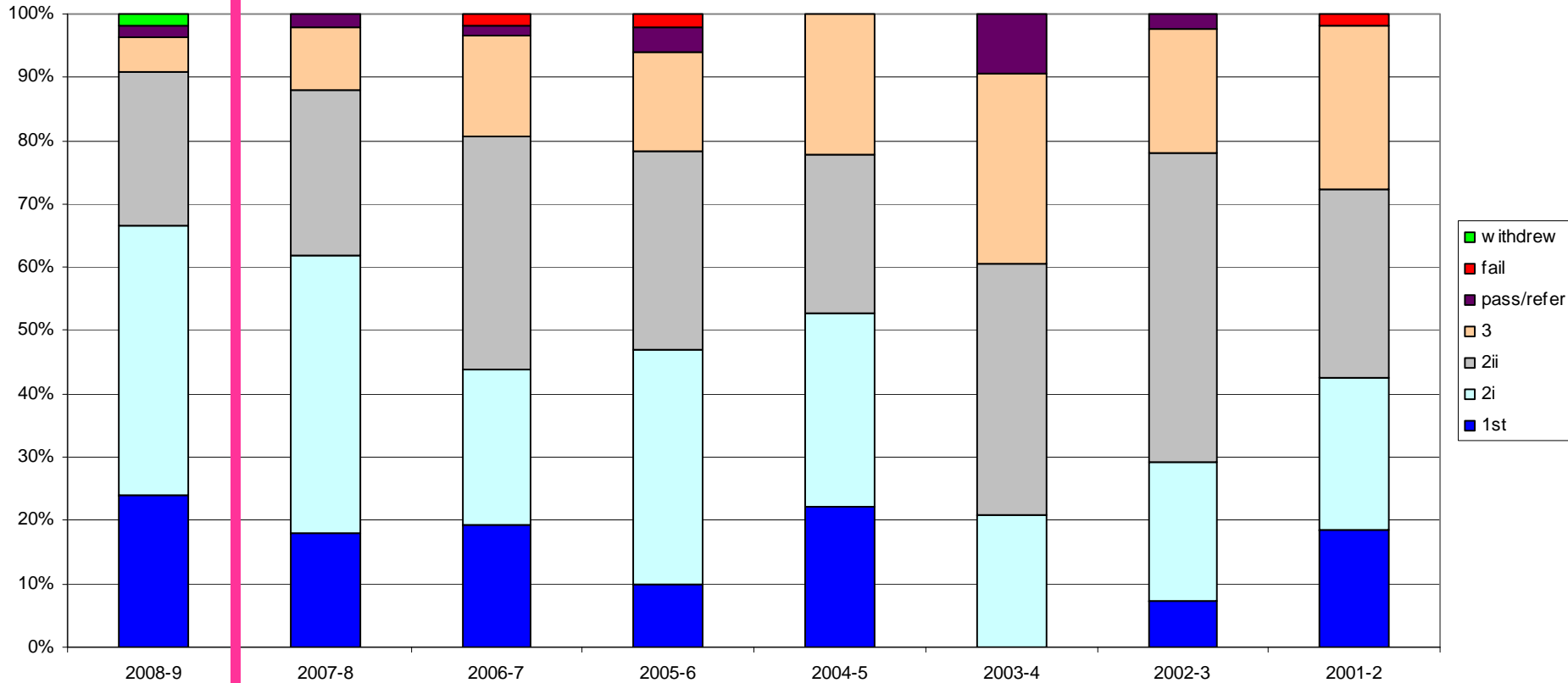
3rd year marks



New

Old degree programmes

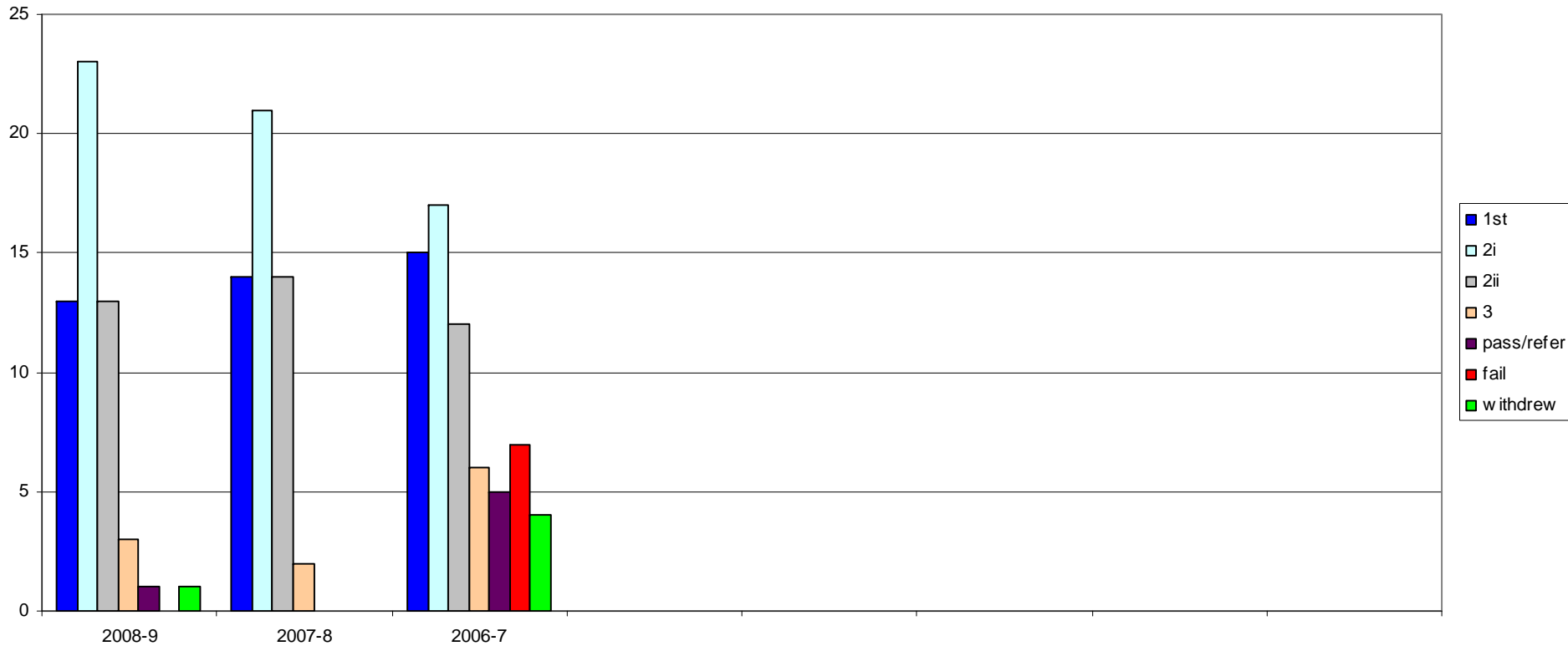
3rd year marks



New | **Old degree programmes**

Cohort mains performance across all 3 years

2006 Intake
 - comparing their 1st, 2nd and 3rd year marks



Summary

- Three A-grades are now required for entry to the new degrees
- Student performance is consistent across all years of study
- 1st year failure rate has fallen from 20% to under 5%
- 2nd year performance, traditionally weak, has been transformed
- Results from the 3rd year, which follows the traditional degree programme, are also improved
- Around 20% of the cohort choose to take their 3rd year abroad
- Even sceptical staff are positive about the new structure